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NATIONAL DAM INSPECTION PROGRAM. SPRING BROOK INTAKE DAM (NDI I--ETC(U)
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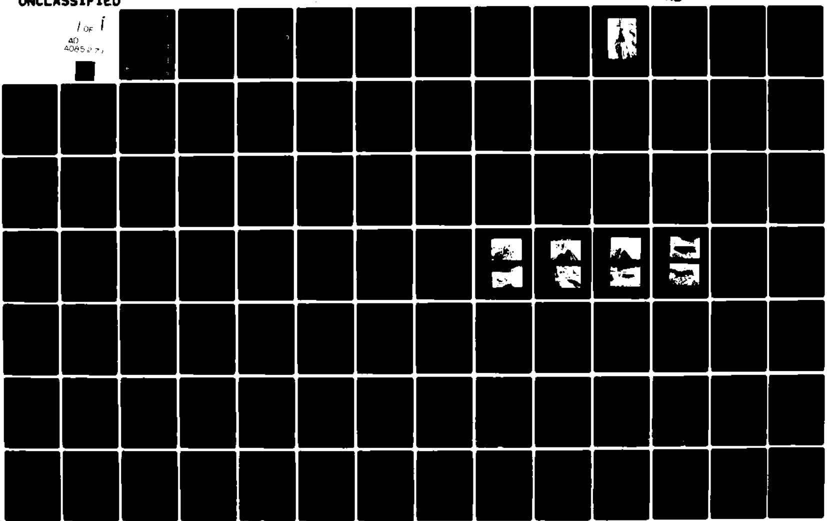

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LEVEL II

SUSQUEHANNA RIVER BASIN

SPRING BROOK, LACKAWANNA COUNTY

PENNSYLVANIA

SPRING BROOK INTAKE DAM

NDI ID NO. PA-00450
DER ID NO. 35-40

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

Prepared by
GANNETT FLEMING CORDDRY AND CARPENTER, INC
Consulting Engineers
Harrisburg, Pennsylvania 1

For
DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

APRIL 1980

GANNETT FLEMING CORDDRY AND CARPENTER, INC.

DACW-31-80-C-0017

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DISCLAIMER NOTICE

SUSQUEHANNA RIVER BASIN

SPRING BROOK, LACKAWANNA COUNTY

PENNSYLVANIA

(10) Frederick / Futchko

SPRING BROOK INTAKE DAM

NDI ID No. PA-00450
DER ID No. 35-40

PENNSYLVANIA GAS AND WATER COMPANY

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PHASE I INSPECTION REPORT

(6) NATIONAL DAM INSPECTION PROGRAM. Spring Brook Intake Dam (NDI ID Number PA-00450, DER ID Number 35-40), Susquehanna River Basin, Spring Brook, Lackawanna County, Pennsylvania. Phase I Inspection Report,

~~Prepared by~~

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
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For

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

(11) APR [redacted]980

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

SUSQUEHANNA RIVER BASIN

SPRING BROOK, LACKAWANNA COUNTY

PENNSYLVANIA

SPRING BROOK INTAKE DAM

NDI ID No. PA-00450
DER ID No. 35-40

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

APRIL 1980

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PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

BRIEF ASSESSMENT OF GENERAL CONDITION

AND

RECOMMENDED ACTION

Name of Dam:	Spring Brook Intake Dam NDI ID No. PA-00450 DER ID No. 35-40
Size:	Small (33 feet high; 238 acre-ft)
Hazard Classification:	High
Owner:	Pennsylvania Gas and Water Company J. Glenn Gooch, President 39 Public Square Wilkes-Barre, Pa. 18711
State Located:	Pennsylvania
County Located:	Lackawanna
Stream:	Spring Brook
Date of Inspection:	26 October 1979

Based on visual inspection, available records, calculations, past operational performance, and according to criteria established for these studies, Spring Brook Intake Dam is judged to be in good condition. Based on the size and hazard classification of the dam, the recommended Spillway Design Flood (SDF) varies between 1/2 the Probable Maximum Flood (PMF) and the PMF. Based on the criteria and the downstream conditions, the selected Spillway Design Flood (SDF) at the dam is the Probable Maximum Flood (PMF). The existing spillway will pass about 53 percent of the PMF without overtopping of the dam. The spillway capacity is rated as inadequate. If the low area on the top of the dam were filled to the design elevation, the spillway would pass about 56 percent of the PMF, and it would still be rated as inadequate. → next page

The only stability problem evident at the dam is a bulge on the upstream slope of the embankment. The main and auxiliary spillway weirs have no significant deviations from the OCE guidelines for stability of gravity structures.

There are two emergency drawdown facilities at the dam. One of these facilities is operational, but because of its small size, its ability to draw down the pool is marginal. The ability of the other facility to function is uncertain.

The following studies and remedial measures are recommended to be undertaken by the Owner, in approximate order of priority, immediately:

(1) If the recently placed fill has not raised the embankment to its design elevation, then provide additional fill to accomplish this.

(2) Flatten the upstream slope of the embankment or provide other remedial measures as required to remove the bulge and stabilize the slope. The design of these measures should be performed by a professional engineer experienced in the design and construction of dams.

(3) Repair the flooring in the right outlet works valve chamber and ensure the operational adequacy of the emergency drawdown valve. Operate it on a regular basis.

(4) Investigate the toe of the auxiliary spillway apron to determine if scour has occurred. If it has occurred, provide remedial measures.

(5) As part of the regular maintenance program, remove the small tree at the toe of the embankment and increase the frequency of brush cutting.

In addition, the Owner should institute the following operational and maintenance procedures:

(1) Develop a detailed emergency operation and warning system for Spring Brook Intake Dam.

(2) During periods of unusually heavy rains, provide round-the-clock surveillance of Spring Brook Intake Dam.

(3) When warnings of a storm of major proportions are given by the National Weather Service, the Owner should activate his emergency operation and warning system.

(4) As presently required by the Commonwealth, submit an annual inspection report for Spring Brook Intake Dam to the Commonwealth.

(5) Expand the existing maintenance program so that all features of the dam are properly maintained.

Submitted by:

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.

FREDERICK FUTCHKO
Project Manager, Dam Section

Date: 2 May 1980

Approved by:

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

Date: 16 May 1980

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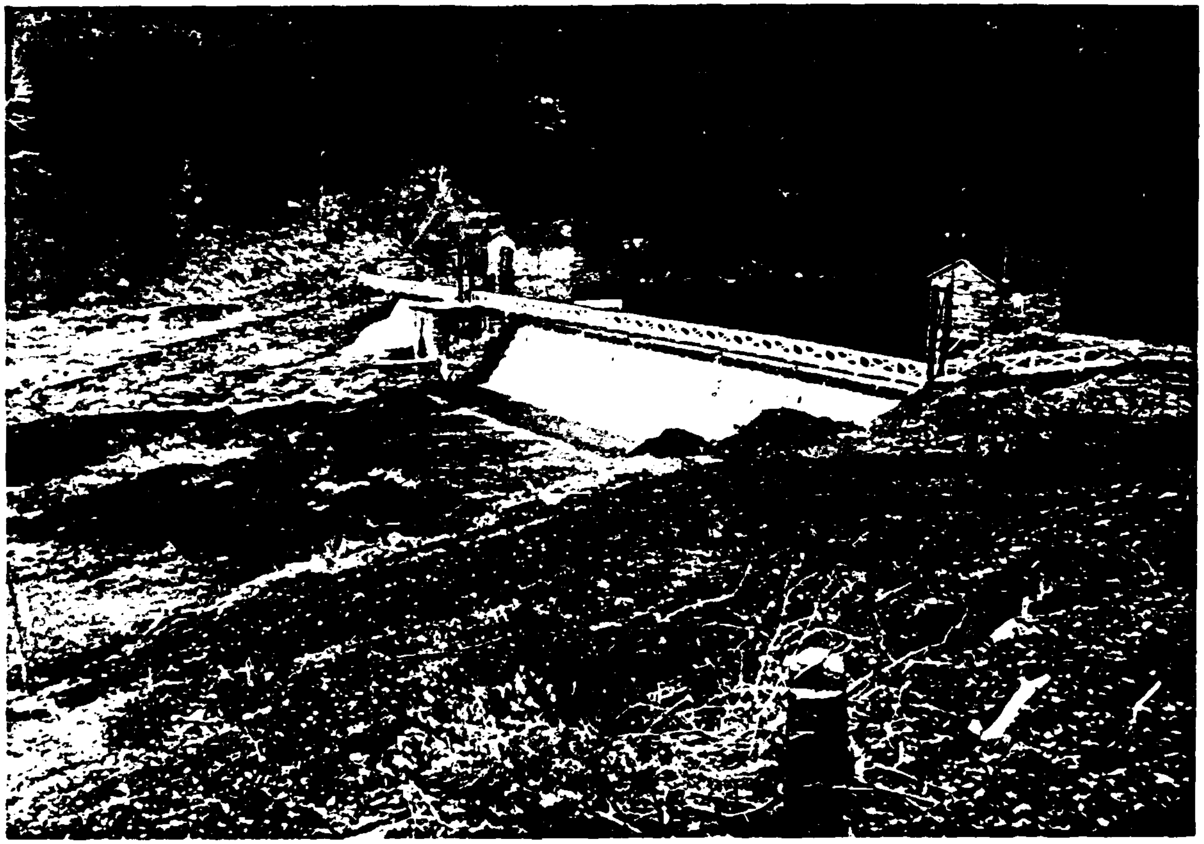
SPRING BROOK INTAKE DAM



Overview

SUSQUEHANNA RIVER BASIN

SPRING BROOK, LACKAWANNA COUNTY

PENNSYLVANIA

SPRING BROOK INTAKE DAM

NDI ID No. PA-00450
DER ID No. 35-40

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

APRIL 1980

SECTION 1

PROJECT INFORMATION

1.1 General.

a. Authority. The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Spring Brook Intake Dam consists of an embankment, two spillways, and two outlet works structures. The overall length of the dam including the two spillways is about 330 feet. The height of the dam at maximum section is 33 feet. The embankment portion of

the dam is 82 feet long and is located at the left abutment of the dam. A masonry corewall extends within part of the embankment.

The left outlet works is located at the right end of the embankment. It is a stone masonry structure containing both water supply and emergency drawdown facilities. To the right of the left outlet works is the main spillway. It is a stone masonry gravity structure with a broad-crested weir. The weir is 145 feet long and the crest is 12.1 feet below the design top elevation of the embankment. At the right end of the main spillway is the right outlet works, which is a stone masonry structure containing both water supply and emergency drawdown facilities.

The auxiliary spillway is at the right abutment of the dam. It is a concrete and stone masonry gravity structure with a rounded crest. The crest is 67 feet long and is at the same elevation as the main spillway. At the right end of the auxiliary spillway is a masonry wall that ties into bedrock.

Aprons extend downstream of both spillways. Although both spillway crests are at the same elevation, the right spillway is termed the auxiliary spillway in this Report to differentiate it from the main, or left, spillway. The various features of the dam are shown on the Photographs in Appendix C and on the Plates in Appendix E. A description of the geology is included in Appendix F.

b. Location. Spring Brook Intake Dam is located on Spring Brook in Spring Brook Township, Lackawanna County, Pennsylvania, approximately 3 miles southeast of Moosic. Spring Brook Intake Dam is shown on USGS Quadrangle, Avoca, Pennsylvania, at latitude N 41° 19' 50" and longitude W 75° 41' 10". A location map is shown on Plate E-1.

c. Size Classification. Small (33 feet high, 238 acre-feet).

d. Hazard Classification. High hazard. Downstream conditions indicate that a high hazard classification is warranted for Spring Brook Intake Dam (Paragraphs 3.1e and 5.1c (5)).

e. Ownership. Pennsylvania Gas and Water Company, J. Glenn Gooch, President, 39 Public Square, Wilkes-Barre, Pennsylvania 18711.

f. Purpose of Dam. Water supply.

g. Design and Construction History. Spring Brook Intake Dam was constructed in 1894 under the supervision of William M. Marple, who also designed the dam. The contractor who performed the work is not known. The dam performed satisfactorily until May 1942, when the dam overtopped by 2.6 feet. The embankments at both abutments washed out; however, the corewalls in the embankments remained intact and the dam did not fail.

In June 1942, Thomas H. Wiggin, consulting engineer of New York City, prepared a report on the overtopping. The report recommended that an additional spillway be constructed at the site of the right embankment and that the left embankment be raised. Mr. Wiggin subsequently designed these modifications. The Commonwealth approved the design, and construction was started in November 1942. The work was completed in October 1944. Roy A. Transue supervised the work until May 1944, after which Raymond E. Lueder became supervisor. The contractor was William B. Huxster of Dover Hills, New Jersey.

The Owner has modified the water supply piping at various times to suit his needs. At present, the Owner intends to install a travelling screen at the right outlet works during the spring of 1980.

h. Normal Operational Procedure. The pool is maintained at the spillway crest level with excess inflow discharging over the spillways. The emergency drawdown facilities are not normally used. Spillway discharge flows downstream in Spring Brook to the confluence with the Lackawanna River.

1.3 Pertinent Data.

a. Drainage Area. (square miles)	42.3
b. Discharge at Damsite. (cfs.)	
Maximum known flood at damsite	9,000
Outlet works at maximum pool elevation	
Left outlet works	40
Right outlet works	170
Spillway capacity (combined-main and auxiliary) at maximum pool elevation	

b. Discharge at Damsite. (cont'd.)

Design conditions	29,860
Existing conditions	28,030

c. Elevation. (feet above msl.)

Top of dam	
Design conditions	922.1
Existing conditions	921.6
Maximum pool	
Design conditions	922.1
Existing conditions	921.6
Normal pool (spillway crests)	910.0
Upstream invert outlet works	Not available
Downstream invert outlet works	
Left outlet works	891.4
Right outlet works	892.3
Streambed at toe of dam	889.0

d. Reservoir Length. (miles)

Normal pool	0.23
Maximum pool (design)	0.45

e. Storage. (acre-feet)

Normal pool	78
Maximum pool (design)	247
Maximum pool (existing)	238

f. Reservoir Surface. (acres)

Normal pool	9.7
Maximum pool (design)	18.4

g. Dam. (cont'd.)

Type	Earthfill with masonry corewall.
Length (feet)	82
Height (feet)	
To toe of embankment	29
To streambed at main spillway	33
Topwidth (feet)	Varies, 9 feet minimum

g. Dam. (cont'd.)

Sides Slopes	
Upstream	
above El 912.5	1V on 1H
below El 912.5	1V on 2.5H
Downstream	Varies, 1V on 1.75H minimum
Zoning	Corewall.
Cut-off	Corewall founded in cutoff trench.
Grout Curtain	None.

h. Diversion and Regulating Tunnel. — None.

i. Spillway.

Type	
Main (at left side)	Broad-crested stone masonry gravity weir.
Auxiliary (at right side)	Round nosed concrete and stone masonry gravity weir.
Length of Weir (feet)	
Main	145.0
Auxiliary	67.0
Crest Elevation	
Main	910.0
Auxiliary	910.0
Upstream Channel	
Main	Reservoir.
Auxiliary	Short adverse sloped channel submerged in reservoir.
Downstream Channel	
Main	Grouted stone apron.
Auxiliary	Grouted stone and concrete apron.

j. Regulating Outlets.

Type.

Left Outlet Works	One 24-inch dia. CIP with 14-inch dia. CIP tapping off line.
Right Outlet Works	One 36-inch dia. CIP reduced to a 30-inch diameter CIP at the outfall.

Length (feet)

Left Outlet Works	48
Right Outlet Works	47

Closure

Left Outlet Works	Valve near downstream end.
Right Outlet Works	Valve near downstream end in valve house.

Access

Left Outlet Works	At toe of left outlet works.
Right Outlet Works	Valve house at right outlet works.

SECTION 2

ENGINEERING DATA

2.1 Design.

a. Data Available. No design data are available for the original dam. In 1914, the Pennsylvania Water Supply Commission prepared a report on the dam. The only criticism they made concerning the design was the spillway capacity, which has since been modified. Design data available for the 1942 modifications include design drawings, a permit application report, specifications, and stability analyses.

b. Design Features. The project is described in Paragraph 1.2a. The various features of the dam are shown on the Photographs in Appendix C and on the Plates in Appendix E.

c. Design Considerations. Nothing was noted in the review of the design data for the 1942 modifications that would cause concern except for the steep upstream slope. The specifications for the 1942 modifications were detailed and generally reflected good engineering practice.

2.2 Construction.

a. Data Available. No construction data are available, except for as-built sections, as shown on Plate E-3. There are some data for the foundations of the various structures.

b. Construction Considerations. There are insufficient data to assess the construction.

2.3 Operation. There are no formal records of operation. A record of operation does exist in the form of inspection reports prepared by the Commonwealth between 1917 and 1964 and previous inspections by the Owner. The previous inspections only note minor maintenance discrepancies.

2.4 Evaluation.

a. Availability. Engineering data were provided by the Bureau of Dams and Waterway Management, Department of Environmental Resources, Commonwealth of Pennsylvania

(PennDER). The Owner made available an engineer for information during the visual inspection. He also researched his files for information at the request of the inspection team.

b. Adequacy. The type and amount of available design data and other engineering data are limited, and the assessment must be based on the combination of available data, visual inspection, performance history, hydrologic assumptions, and hydraulic assumptions.

c. Validity. There is no reason to question the validity of the available data.

SECTION 3

VISUAL INSPECTION

3.1 Findings.

a. General. The overall appearance of the dam is good. Some deficiencies were observed as noted below. A sketch of the dam with the locations of deficiencies is presented on Exhibit B-1 in Appendix B. Survey information acquired for this Report is summarized in Appendix B. Datum for the survey was taken at the main spillway crest, Elevation 910.0, as shown on USGS mapping. The Owner uses a different datum. To convert the elevations on the Plates in Appendix E, 794.1 feet must be added to the elevations on those Plates. On the day of the inspection, the pool was at the spillway crest level. The dam was revisited about 2 weeks after the inspection so that additional photographs could be obtained. The spillway discharge shown on the photographs is significantly greater than the discharge that was occurring on the day of the inspection. During the revisit, it was noted that the Owner had regraded the top of the embankment. He subsequently reported that the regrading had been performed when a chlorine line to the water supply facilities was installed. He did not have any elevation data for the regrading. However, the top of the embankment is higher than indicated by the profile in Appendix B.

b. Embankment. The lower part of the downstream slope is grass covered. The upper part of the downstream slope and the top of the embankment are bare soil (Photograph A). One small tree is growing at the downstream toe (Photograph B). The part of the upstream slope that is above normal pool is protected by hand-placed riprap. There is a bulge on the upstream slope that protrudes a maximum of about 3 feet (Photograph B). The upstream slope above normal pool is very steep. The slope flattens significantly near the normal pool elevation.

The survey performed for this inspection reveals that the upstream and downstream slopes are close to the design slopes. The existing topwidth is, as a minimum, the design topwidth. Regrading for vehicular access has widened the topwidth beyond its design value. The regrading has also obscured the left end of the embankment.

c. Appurtenant Structures. The main spillway and main spillway apron are in good condition (Photographs C,

E, and F). Some minor deterioration of some mortar was evident. The auxiliary spillway and auxiliary spillway apron are also in good condition, with the mortar in approximately the same condition as the main spillway (Photographs G and H). Probing with a rod indicated that a hole about 8 feet deep exists at one location immediately downstream of the downstream end of the auxiliary spillway apron. Fairly large brush stumps were observed at the right abutment of the dam.

The left outlet works is in good condition. There is minor leaching at the retaining walls at the outlet works. The emergency drawdown valve, which is outside the structure (Photograph D), was operated by the Owner without any problem.

The right outlet works intake chamber is in good condition. Electrical work was in progress for the installation of the travelling screen, as noted in Paragraph 1.2g. The timber flooring in the valve chamber is warped severely, making access to the valves very difficult. Leaching is evident on both the interior and exterior walls of the structure.

The suspension bridge, which is downstream of the spillway crests, is in good condition.

d. Reservoir Area. The watershed area is mostly wooded, with only an insignificant amount of rural development. There are some dams in the watershed, as discussed in Section 5. At the reservoir, the slopes are steep and wooded. There are some rock outcrops in the reservoir area.

e. Downstream Channel. At the damsite, the downstream channel is unobstructed. Spring Brook flows downstream in a channel that is 8 to 10 feet below the relatively flat overbanks. Within a reach that extends for 1.5 miles downstream from the dam, there are over 30 dwellings as well as a trailer park that could be flooded by a failure of the dam.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedure. The reservoir is maintained at spillway crest, with excess inflow discharging over the spillway and into Spring Brook. Water supply lines at the dam are connected directly to the Owner's distribution system. The emergency drawdown facilities are normally not used. The dam is an important part of the Owner's water supply system. Water supply demand at the dam is usually 8 to 10 mgd.

4.2 Maintenance of Dam. The dam is visited daily by a caretaker who records the reservoir elevation. Weekly reports are mailed to the Owner's Engineering Department. This information is used by the Owner's Engineering Department for regulating flows in the distribution system. The caretaker is also responsible for observing the general condition of the dam and appurtenant structures and reporting any changes or deficiencies to the Owner's Engineering Department. A Pennsylvania Gas and Water Company engineer makes a formal inspection of the dam each year, and the records are filed and used for determining priority of repairs. Informal inspections are also made when the engineer is on the site for other reasons. In response to the National Dam Inspection Program of the two previous years, the Owner has modified his maintenance and inspection programs. All maintenance, except for minor items, is performed under contract with outside firms. The Owner's operating personnel observe the maintenance performed by outside firms in order to become familiar with required maintenance work. The Owner plans to have all maintenance work performed by his operating personnel within a few years. The emphasis of the maintenance work has been placed on those structures previously inspected under the National Dam Inspection Program. Annual inspection reports for those dams inspected under the National Dam Inspection Program are submitted to the Commonwealth.

4.3 Maintenance of Operating Facilities. The left emergency drawdown valve is operated periodically. The right emergency drawdown valve is not maintained. It has not been operated recently. Maintenance for the water supply outlets is performed on an as-needed basis.

4.4 <u>Warning Systems in Effect</u>. The Owner furnished the inspection team with a verbal description of the chain of command diagram for Spring Brook Intake Dam and of a generalized emergency notification list that is applicable for all of the Pennsylvania Gas and Water Company dams. The Owner said that during periods of heavy rainfall, available personnel are dispatched to the dams to observe conditions. All company vehicles are equipped with radios, and the personnel can communicate with each other and with a central control facility. Evaluation of risk is made by the Owner's Engineering Department. The Owner's Engineering Department is also responsible for notification of emergency conditions to the local authorities. Detailed emergency operational procedures have not been formally established for Spring Brook Intake Dam, but are as directed by the Owner's Engineering Department.

4.5 <u>Evaluation of Operational Adequacy</u>. The maintenance of the right emergency drawdown outlet works is inadequate. The maintenance of the dam is adequate. The inspection program for the dam is good. A detailed emergency operation and warning system is necessary to reduce the risk of dam failure should adverse conditions develop and to prevent loss of life should the dam fail.

SECTION 5

HYDROLOGY AND HYDRAULICS

5.1 Evaluation of Features.

a. Design Data. No design data are available for the hydraulics of the original structure. After the dam overtopped in 1942, a report was prepared by Thomas H. Wiggin; it recommended modifications to increase the spillway capacity to 25,000 cfs. This spillway capacity was based on the spillway capacity of Nesbitt Dam, which is upstream, combined with an estimated runoff from the drainage area between Nesbitt Dam and Spring Brook Intake Dam. The Commonwealth analyzed the modifications designed by Mr. Wiggin. They determined the modified spillway capacity to be 29,820 cfs. Their analysis is reasonable and is used for the analysis described in Appendix D. The drainage area of 42.3 square miles that is used in this Report was taken from recent USGS mapping. The records indicate that the drainage area is 43.2 square miles. The difference is minor.

b. Experience Data. The dam was overtopped in May 1942. Extensive damage occurred during the overtopping but the dam did not fail. Mr. Wiggin's estimate of 9,000 cfs peak flow for this overtopping is used as the flood of record.

c. Visual Observations.

(1) General. The visual inspection of Spring Brook Intake Dam, which is described in Section 3, resulted in a number of observations relevant to hydrology and hydraulics. These observations are evaluated herein for the various features.

(2) Embankment. The low area on the top of the embankment limits the existing spillway capacity to less than the design capacity.

(3) Appurtenant Structures. No deficiencies relevant to hydraulics were observed at the main spillway, the main spillway apron, or the auxiliary spillway. The hole at the toe of the auxiliary spillway apron may indicate scour has occurred at this area. As shown on Plate E-2, a structure used to exist at this area. It is also possible that the hole may be the foundation of the

structure. If scour has occurred, then the auxiliary spillway apron could be undermined. This would not be a hazard to the dam unless it were to be neglected for a long time.

No deficiencies relevant to hydraulics were observed at the left outlet works. However, since the drainage area at the site is large, the capability of the left outlet works, by itself, to draw down the pool is marginal.

The warped flooring at the right outlet works indicates that the right outlet works valve has probably not been operated recently. The Owner only operated the left outlet works. The right outlet works was not operated since access to the valves would be quite difficult because of the condition of the flooring.

(4) Reservoir Area. A negligible amount of rural development is in the watershed. There are five impoundments within the watershed, as noted in Appendix D. Phase I National Dam Inspection Reports are available for Maple Lake Dam, Watres Dam, and Nesbitt Dam. Maple Lake Dam is an intermediate size dam. Nesbitt and Watres Dams are large size dams. These three dams have seriously inadequate spillways. The other two dams are sufficiently small that they would have no significant effect on the hydrology at Spring Brook Intake damsite. In the Phase I Report for Maple Lake Dam, it was shown that the failure of Maple Lake Dam would not cause the overtopping of Nesbitt Dam, considering that no other inflow to Nesbitt Dam occurs. Since Maple Lake Dam also controls only a small part of the Spring Brook Intake Dam watershed, it was decided to include only Nesbitt and Watres Dam in the analysis described hereafter.

(5) Downstream Conditions. No conditions were observed downstream from the dam that would reduce the spillway discharge capacity. Failure of Spring Brook Intake Dam would probably flood over 30 dwellings as well as a trailer park, with a resultant potential for loss of life. The downstream conditions indicate that a high hazard classification is warranted for Spring Brook Intake Dam.

d. Overtopping Potential.

(1) Spillway Design Flood. According to the criteria established by the Office of the Chief of Engineers (OCE), the Spillway Design Flood (SDF) for the

size (Small) and hazard potential (High) of Spring Brook Intake Dam is between one-half of the Probable Maximum Flood (PMF) and the PMF. Because of the downstream conditions, the PMF is selected as the SDF for Spring Brook Intake Dam. The watershed was modeled with the HEC-1DB computer program. A description of the model is included in Appendix D. The assessment of hydrology and hydraulics is based on existing conditions, and the effects of future development are not considered.

(2) Summary of Results. Pertinent results are tabulated at the end of Appendix D. The analysis reveals that Spring Brook Intake Dam can pass about 53 percent of the PMF before overtopping of the dam occurs. The dam is rated at its existing top elevation. At its design top elevation, the dam can pass about 56 percent of the PMF. As part of this study, it was also found that Nesbitt and Watres Dams, located upstream from Spring Brook Intake Dam, will pass 45 and 56 percent, respectively, of their components of the PMF before being overtopped.

(3) Spillway Adequacy. The criteria used to rate the spillway adequacy of a dam are described in Appendix D. Because Spring Brook Intake Dam can pass the 1/2 PMF but not the PMF, the spillway capacity of Spring Brook Intake Dam is rated as inadequate. If the top of the embankment were raised to its design elevation, the spillway capacity would still be rated as inadequate.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations.

(1) General. The visual inspection of Spring Brook Intake Dam, which is described in Section 3, resulted in a number of observations relevant to structural stability. These observations are evaluated herein for the various features.

(2) Embankment. The growth of the tree on the downstream slope is a minor hazard at present. Root systems of large trees can loosen embankment material, displace slope protection, and create paths along which seepage and piping (internal erosion) might occur.

The bulge on the upstream slope of the embankment is a hazard to the dam. The 1V on 1H part of the upstream slope only extends down to Elevation 912.5, which is 2.5 feet above normal pool. This slope is much steeper than slopes normally used on earthfill embankments. Because the toe of the steep slope is above normal pool level and because the bulge appears to be a localized stability problem that does not extend below Elevation 912.5, a hazard would only exist when the reservoir is substantially above normal pool levels. The bulge is not noted in any previous inspection performed by either the Commonwealth or the Owner. The bulge was known to exist in June 1978, when a brief visit to Spring Brook Intake Dam was made as part of the Phase I inspection for Nesbitt Dam. As the top of the embankment is used for vehicular access, vehicular surcharge loadings may have caused the bulge. Were a slide to occur at the area, the top of the dam would be lowered; this would reduce the spillway capacity.

(3) Appurtenant Structures. The possible scour hole at the toe of auxiliary spillway apron, which is assessed in Section 5, is the only structural deficiency at the spillways and the outlet works.

b. Design and Construction Data. No stability analyses were available for the embankment or the main spillway weir. A stability analysis was available for the

auxiliary spillway weir. It was performed by Thomas H. Wiggin during the design of the 1942 modifications to the dam. The forces considered were water pressure, weight of the structure, earth pressure, and 50 percent uplift. The resultant was within the middle third of the base. For this Report, the stability of the main and auxiliary spillway weirs were checked under the maximum loading conditions. Earth pressure and uplift were included in the analyses. For the maximum loading condition, pool level at top of dam, the resultant was found to be outside of the middle third of the base, but located within the base. For the main spillway weir, the resultant is 4.5 feet within the toe. For the auxiliary spillway weir, the resultant is 3.6 feet within the toe. The resulting toe pressures and the resistance to sliding were found to be adequate for the assumed maximum loading conditions. Although the spillway weirs do not meet the guidelines of the Office of the Chief of Engineers (OCE) for stability under the assumed maximum loading conditions, the resultants being outside the toes is not deemed to be a significant deviation because the toe pressures are adequate.

c. Operating Records. There are no formal records of operation. According to available records, no stability problems have occurred over the operational history of the dam. The bulge in the upstream slope was not noted in any inspection reports.

d. Post-construction Changes. Post-construction changes are described in Paragraph 1.2g. The changes have been assessed with the dam.

e. Seismic Stability. Spring Brook Intake Dam is located in Seismic Zone 1. Earthquake loadings are not considered to be significant for small dams located in Seismic Zone 1 when there are no readily apparent stability problems. Since the stone masonry gravity overflow sections of the dam do not have any readily apparent stability problems, the ability of these sections to withstand an earthquake is assumed to be adequate. However, because of the bulge on the upstream slope of the embankment, it is questionable if the embankment could withstand an earthquake loading without a failure at the bulge. If appropriate remedial measures are taken at the bulged area, then the ability of the embankment to withstand an earthquake would be assumed to be adequate.

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND

PROPOSED REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety.

(1) Based on available records, visual inspection, calculations, and past operational performance, Spring Brook Intake Dam is judged to be in good condition. Based on the criteria and the downstream conditions, the SDF at the dam is the PMF. Based on existing conditions, the spillway will pass about 53 percent of the PMF before overtopping of the dam occurs. If the low area on the top of the embankment were filled to the design elevation, the spillway would pass about 56 percent of the PMF. For either condition, the spillway capacity is rated as inadequate.

(2) The only stability problem at the dam is a bulge on the upstream slope of the embankment. The main and auxiliary spillway weirs have no significant deviations from the OCE guidelines for stability of gravity structures.

(3) There are two emergency drawdown facilities at the dam. One of these facilities is operational but, because of its small size, its ability to draw down the pool is marginal. The ability of the other facility to function is uncertain.

(4) A summary of the features and observed deficiencies is listed below:

Feature and Location	Observed Deficiency
Embankment:	Low area; small tree at toe; bulge.
Spillways:	Large brush stumps at right abutment; possible scour hole at toe of auxiliary spillway apron.

Feature and Location	Observed Deficiency
Outlet Works:	Right outlet works: flooring warped over valves; uncertain operation of emergency drawdown facilities.

b. Adequacy of Information. The information available is such that an assessment of the condition of the dam can be inferred from the combination of visual inspection, past performance, and computations performed prior to and as part of this study.

c. Urgency. The recommendations in Paragraph 7.2 should be implemented immediately.

d. Necessity for Further Investigations. In order to accomplish some of the remedial measures outlined in Paragraph 7.2, further investigations by the Owner will be required.

7.2 Recommendations and Remedial Measures.

a. The following studies and remedial measures are recommended to be undertaken by the Owner, in approximate order of priority, immediately:

(1) If the recently placed fill has not raised the embankment to its design elevation, then provide additional fill to accomplish this.

(2) Flatten the upstream slope of the embankment or provide other remedial measures as required to remove the bulge and stabilize the slope. The design of these measures should be performed by a professional engineer experienced in the design and construction of dams.

(3) Repair the flooring in the right outlet works valve chamber and ensure the operational adequacy of the emergency drawdown valve. Operate it on a regular basis.

(4) Investigate the toe of the auxiliary spillway apron to determine if scour has occurred. If it has occurred, provide remedial measures.

(5) As part of the regular maintenance program, remove the small tree at the toe of the embankment and increase the frequency of brush cutting.

b. In addition, the Owner should institute the following operational and maintenance procedures:

(1) Develop a detailed emergency operation and warning system for Spring Brook Intake Dam.

(2) During periods of unusually heavy rains, provide round-the-clock surveillance of Spring Brook Intake Dam.

(3) When warnings of a storm of major proportions are given by the National Weather Service, the Owner should activate his emergency operation and warning system.

(4) As presently required by the Commonwealth, submit an annual inspection report for Spring Brook Intake Dam to the Commonwealth.

(5) Expand the existing maintenance program so that all features of the dam are properly maintained.

APPENDIX A

CHECKLIST - ENGINEERING DATA

CHECKLIST

ENGINEERING DATA

DESIGN, CONSTRUCTION, AND OPERATION
PHASE I

NAME OF DAM: Spring Brook Intake

NDI ID NO.: PA-00450 DER ID NO.: 35-40

ITEM	REMARKS
AS-BUILT DRAWINGS	Not complete See Plates E-2 and E-3
REGIONAL VICINITY MAP	See Plate E-1
CONSTRUCTION HISTORY	Built 1894
TYPICAL SECTIONS OF DAM	See Plates in Appendix E
OUTLETS: Plan Details Constraints Discharge Ratings	See Plates E-2 and E-3 No ratings or constraints

ENGINEERING DATA

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	None
DESIGN REPORTS	For 1942 modification by Thomas H. Wiggin
GEOLOGY REPORTS	None
DESIGN COMPUTATIONS: Hydrology and Hydraulics (H&H) Dam Stability Seepage Studies	Stability and H&H for 1942 modification
MATERIALS INVESTIGATIONS: Boring Records Laboratory Field	See Plate E-3
POSTCONSTRUCTION SURVEYS OF DAM	See Plate E-2

ENGINEERING DATA

ITEM	REMARKS
BORROW SOURCES	NONE
MONITORING SYSTEMS	NONE
MODIFICATIONS	1942 - 1944 SPILLWAY MODIFIED
HIGH POOL RECORDS	MAY 1942 overtopped by 31" SUBSEQUENTLY MODIFIED
POSTCONSTRUCTION ENGINEERING STUDIES AND REPORTS	1942 MODIFICATION
PRIOR ACCIDENTS OR FAILURE OF DAM: Description Reports	See High Pool Records EMBANKMENTS WASHED OUT IN FLOOD OF 1942

ENGINEERING DATA

ITEM	REMARKS
MAINTENANCE AND OPERATION RECORDS	No systematic Records
SPILLWAY: Plan Sections Details	See Plates
OPERATING EQUIPMENT: Plans Details	See Plate E-3
PREVIOUS INSPECTIONS Dates Deficiencies	1917 - No deficiencies 1922 } ONLY PHOTOGRAPHS AVAILABLE 1932 } NO DEFICIENCIES 1934 - MASONRY NEEDS REPOINTING 1941 - TREE IN FILL AT LEFT END, CRACKING SETTLEMENT OF DOWNSTREAM END OF LEFT WALL, CONSIDERABLE FLOW 10' below GATE HOUSE AT RIGHT END 1943 - modifications in progress. 1953 - No deficiencies.
	1957 - No deficiencies. 1965 - No deficiencies.

APPENDIX B

CHECKLIST - VISUAL INSPECTION

CHECKLIST

VISUAL INSPECTION

PHASE I

Name of Dam: Spring Brook Intake **County:** Lackawanna **State:** Pennsylvania

NDI ID No.: PA-00450 **DER ID No.:** 35-40

Type of Dam: Masonry Gravity w/ Earthfill at Left Abutment **Hazard Category:** High

Date(s) Inspection: 26 October 1979 **Weather:** Overcast **Temperature:** 45-50°F

Pool Elevation at Time of Inspection: 910.0 **msl/Tailwater at Time of Inspection:** 891.5 **msl**

Inspection Personnel:

J. Skoritowski (PGW)

D. Wilson (GFCC)

D. Ebersole (GFCC)

A. Whitman (GFCC) **Recorder**

EMBANKMENT AT LEFT ABUTMENT

Sheet 1 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	NONE	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	SEE below	SMALL TREE GROWING IN DOWNSTREAM SLOPE.
SLOUGHING OR EROSION: Embankment Slopes Abutment Slopes	BULGE IN UPSTREAM SLOPE. BULGE PROTRUDES FOR 3'. TOE OF BULGE IS ABOVE NORMAL POOL.	HAND-PLACED RIPRAP ON UPSTREAM SLOPE
CREST ALIGNMENT: Vertical Horizontal	VERTICAL - SEE SURVEY DATA FOLLOWING INSPECTION FORMS HORIZONTAL - NO DEFICIENCIES	
RIPRAP FAILURES	SEE "SLOUGHING OR EROSION"	

EMBANKMENT

Sheet 2 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT WITH: Abutment Spillway Other Features	No Deficiencies	
ANY NOTICEABLE SEEPAGE	None	
STAFF GAGE AND RECORDER	None	
DRAINS	None	

OUTLET WORKS

Sheet 1 of 1

LEFT AND RIGHT REFER TO OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS		REMARKS OR RECOMMENDATIONS
	LEFT	RIGHT	
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	14" CIP	30" CIP	
INTAKE STRUCTURE	LEFT SUBMERGED	RIGHT SUBMERGED	LEACHING AT RETAINING WALL (MINOR)
OUTLET STRUCTURE	LEFT VALVE AT TOE OF OUTLET WORKS	RIGHT VALVE IN VALVE HOUSE. WALLS LEACHING	Both pipes have FREE OUTFALL.
OUTLET CHANNEL	LEFT MAIN SPILLWAY APRON	RIGHT AUXILIARY SPILLWAY APRON	
EMERGENCY ~~GATE~~ VALVE	LEFT OPENED 5% by 2 MEN IN 5 MINUTES	RIGHT FLOORING HAS WARPED UP TO COVER VALVE.	

MAIN
~~UNGATED~~ SPILLWAY (LEFTMOST)

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
~~CONCRETE~~ WEIR MASONRY	GOOD CONDITION	SLIGHT MORTAR DETERIORATION - NO HAZARD AT PRESENT
APPROACH CHANNEL	RESERVOIR - UPSTREAM EARTHFILL NOT OBSERVED.	
DISCHARGE CHANNEL	GROUTED STONE APRON - NO DEFICIENCIES	
BRIDGE AND PIERS	SUSPENSION BRIDGE DOWNSTREAM OF CREST - NO DEFICIENCIES	

AUXILIARY ~~GATED~~ SPILLWAY (RIGHT MOST)

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	No deficiencies	Minor deterioration of mortar - No hazard at present
APPROACH CHANNEL	Submerged	Fairly large stumps at right abutment.
DISCHARGE CHANNEL	Grouted stone apron - No deficiencies	Hole at toe of apron, in streambed, about 8' deep.
BRIDGE AND PIERS	N/A	
GATES AND OPERATION EQUIPMENT	None	

INSTRUMENTATION

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	NONE AT SITE	
OBSERVATION WELLS		
WEIRS		
PIEZOMETERS		
OTHER	NONE AT SITE	

DOWNSTREAM CHANNEL

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION: Obstructions Debris Other	AT DAMSITE: CLEAR	
SLOPES	FAIRLY STEEP	
APPROXIMATE NUMBER OF HOMES AND POPULATION	STREAM 8-10 FEET below OVERBANKS	OVERBANKS FLAT 30+ houses AND A TRAILER PARK ON OVERBANKS

RESERVOIR AND WATERSHED

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Generally steep although some swamps are present	3 significant impoundments in watershed (See Appendix D)
SEDIMENTATION	No observed or reported problems	
WATERSHED DESCRIPTION	Mostly wooded - some farm fields and minor rural development	Considering size - minor rural development

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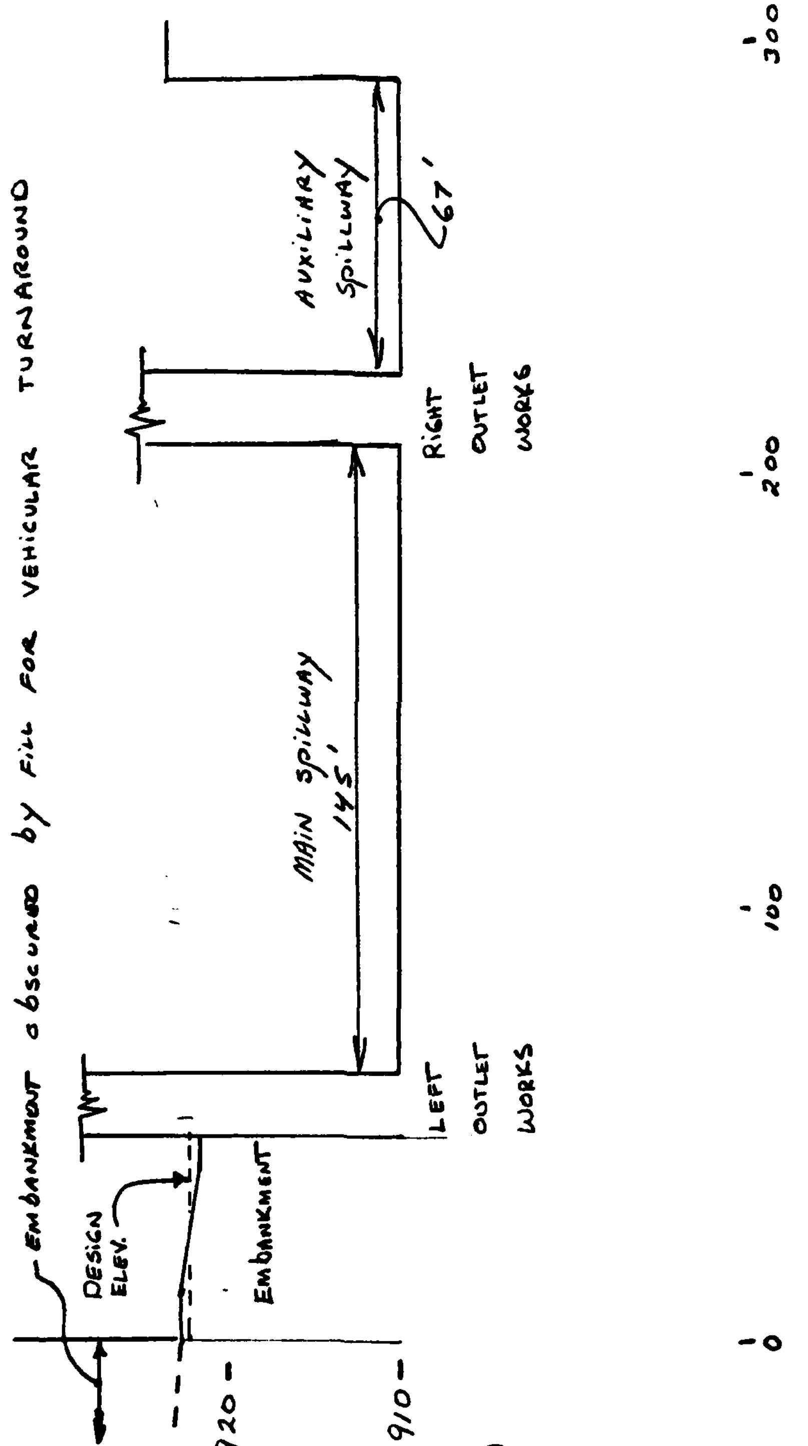
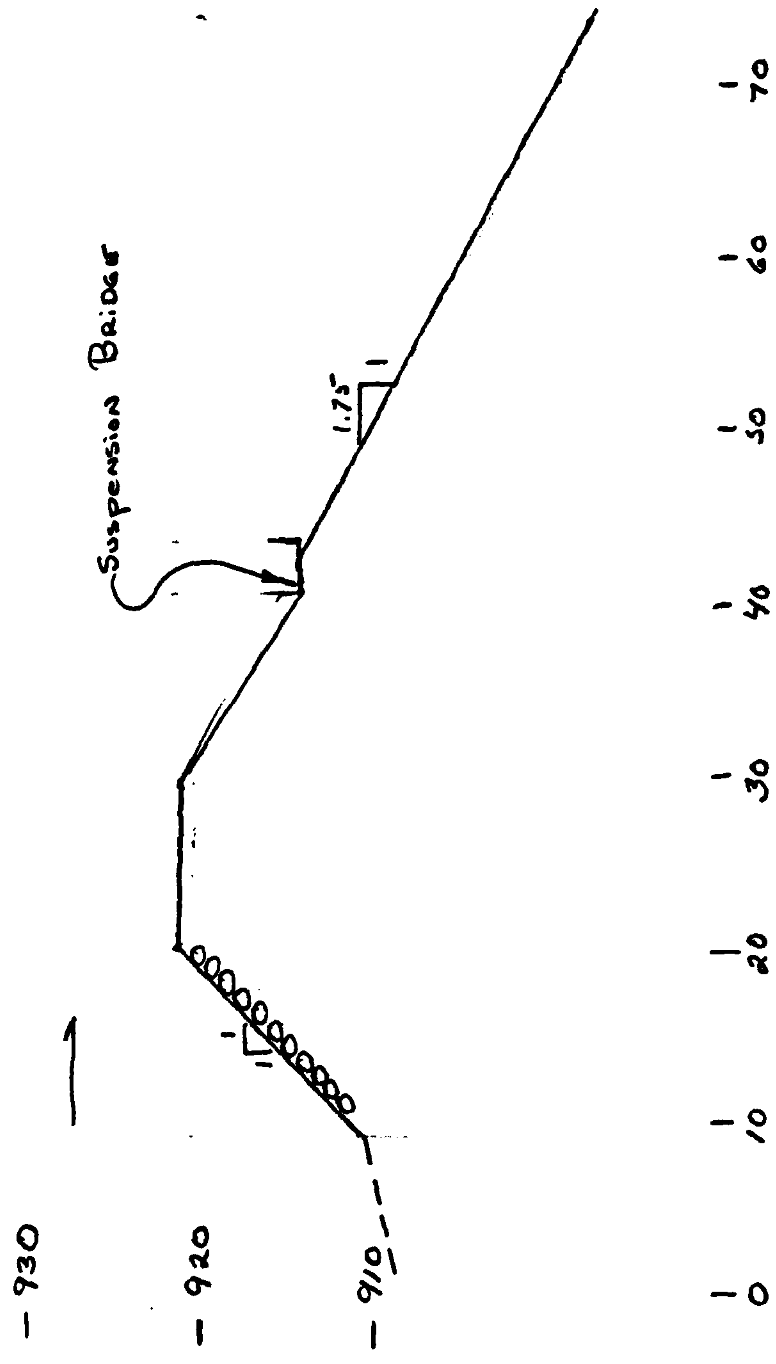
SUBJECT ________ FILE NO. ________
________ SHEET NO. ____ OF ____ SHEETS
FOR ________
COMPUTED BY ________ DATE ________ CHECKED BY ________ DATE ________



PROFILE - LOOKING DOWNSTREAM

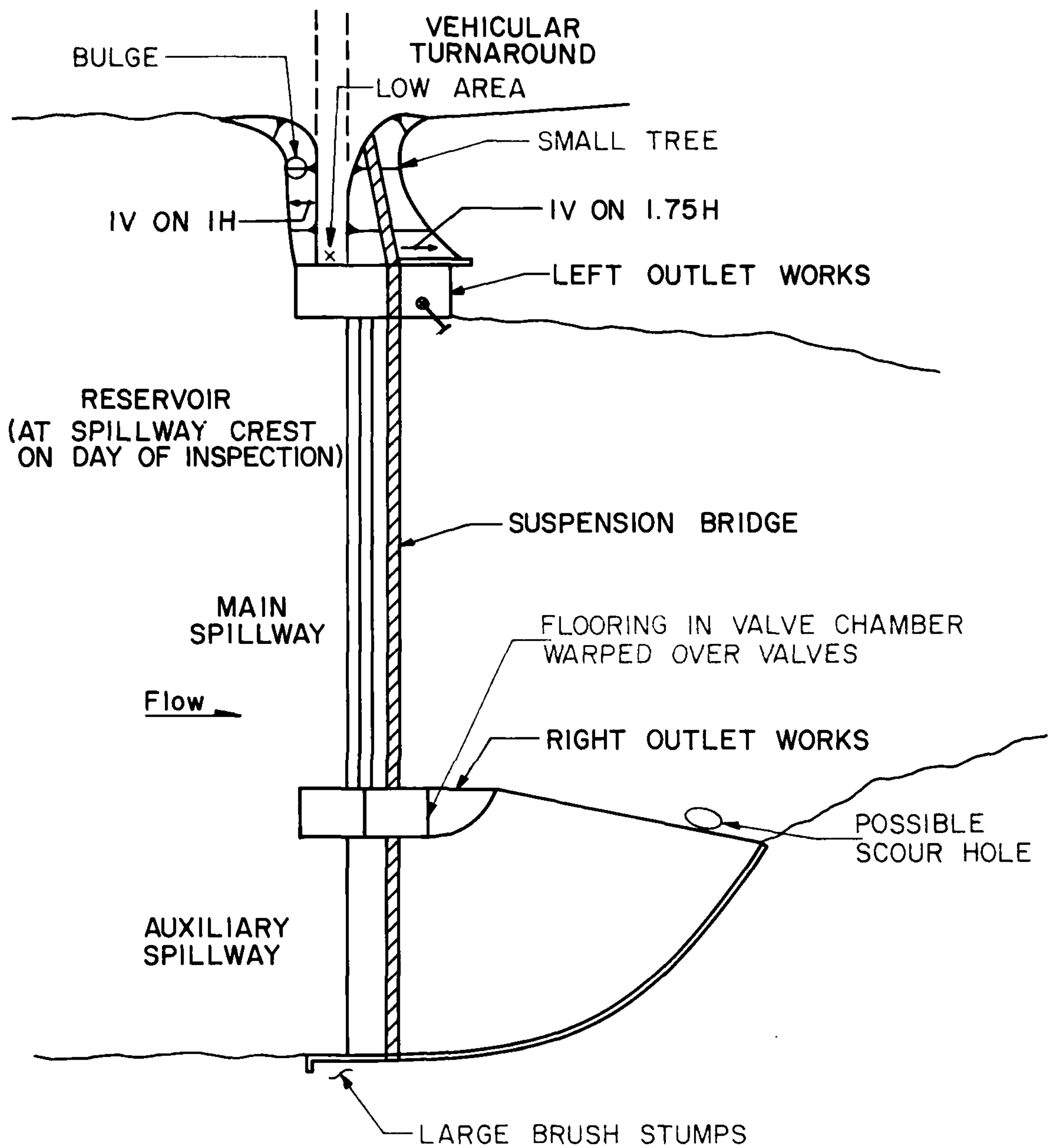
B-10

8313



TYPICAL EMBANKMENT SECTION
(JUST TO LEFT OF LEFT OUTLET WORKS)

8315



NOT TO SCALE

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

SPRING BROOK INTAKE DAM

PENNSYLVANIA GAS AND WATER COMPANY

RESULTS OF VISUAL INSPECTION

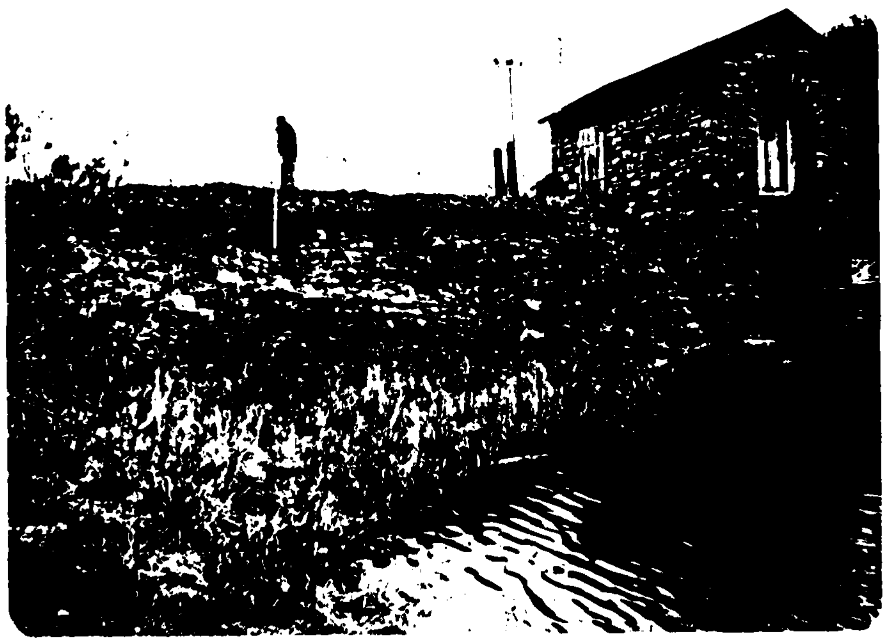
APRIL 1980 EXHIBIT B-1

APPENDIX C

PHOTOGRAPHS

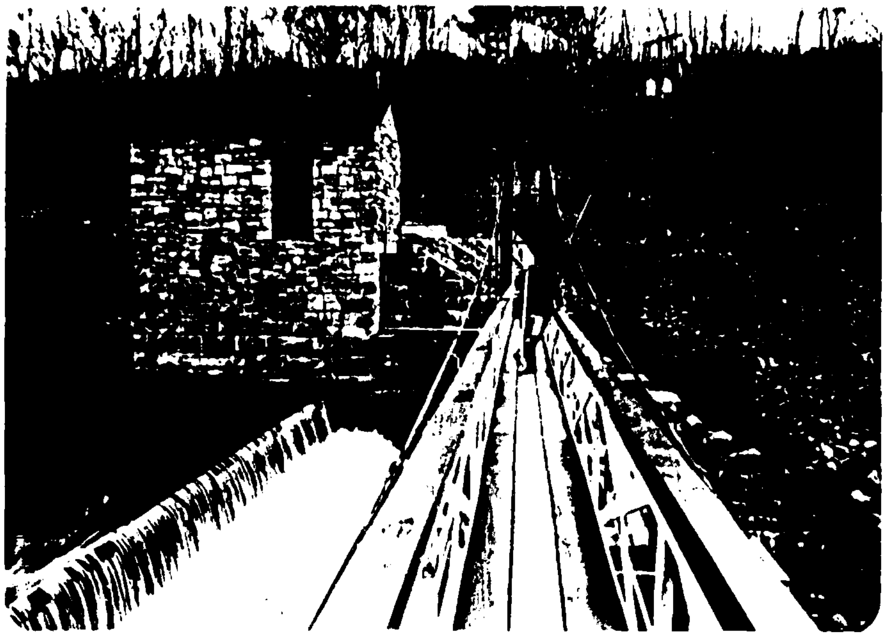
SPRING BROOK INTAKE DAM

A. Embankment - Downstream Slope

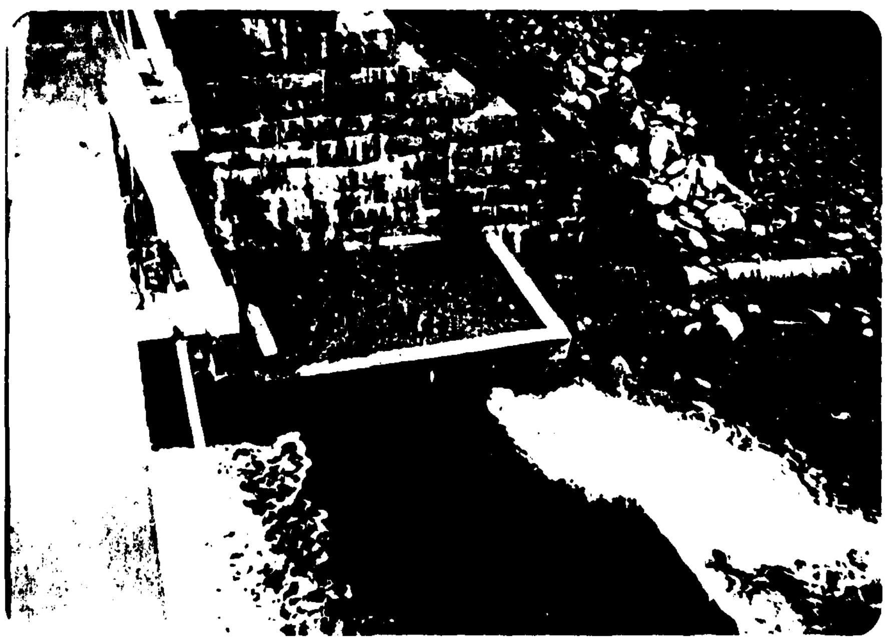


B. Embankment - Upstream Slope and Left Outlet Works

SPRING BROOK INTAKE DAM

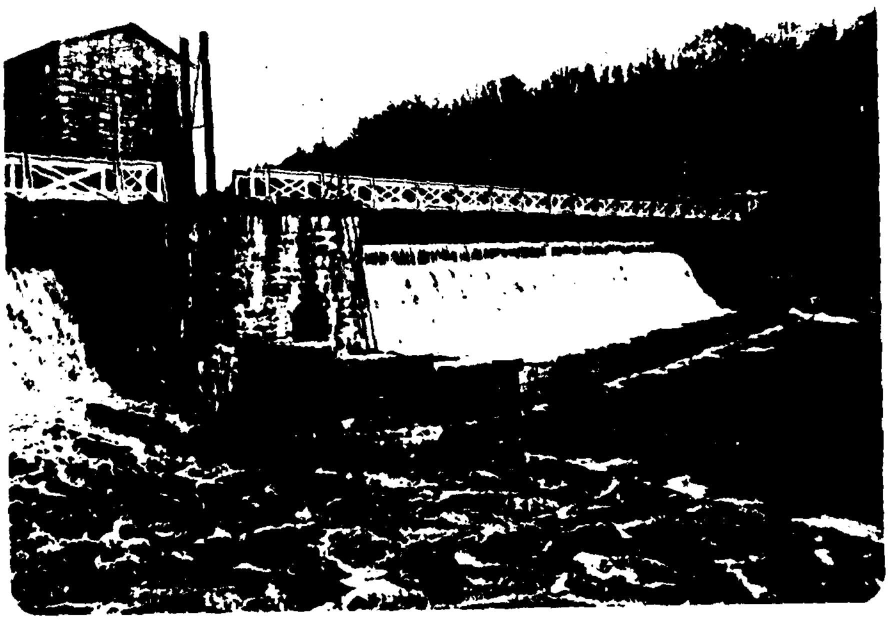


C. Left Outlet Works and Main Spillway

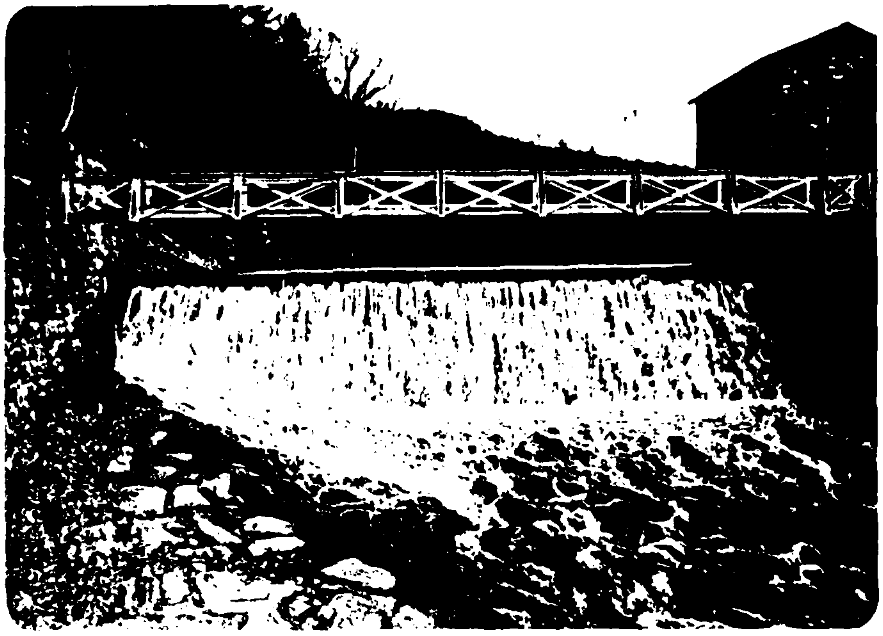


D. Toe of Embankment and Left Outlet Works

E. Main Spillway

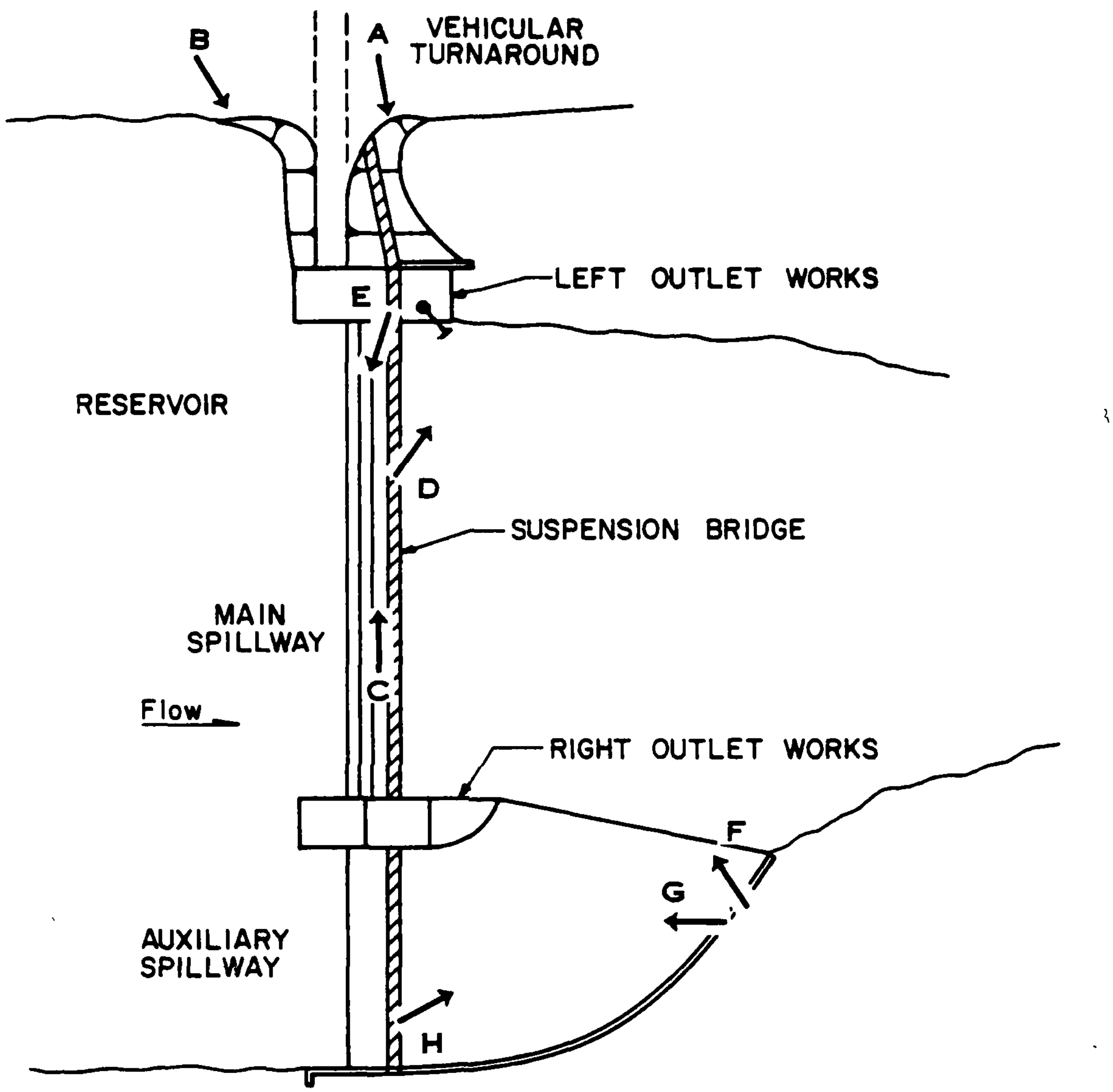


F. Main Spillway and Right Outlet Works



G. Auxiliary Spillway

H. Auxiliary Spillway Apron



← LOCATION AND ORIENTATION OF CAMERA

A PHOTOGRAPH IDENTIFICATION LETTER

NOT TO SCALE

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

SPRING BROOK INTAKE DAM

PENNSYLVANIA GAS
AND WATER COMPANY

**GUIDE TO LOCATION
OF PHOTOGRAPHS**

APRIL 1980 EXHIBIT C-1

APPENDIX D

HYDROLOGY AND HYDRAULICS

APPENDIX D

HYDROLOGY AND HYDRAULICS

Spillway Capacity Rating:

In the recommended Guidelines for Safety Inspection of Dams, the Department of the Army, Office of the Chief of Engineers (OCE), established criteria for rating the capacity of spillways. The recommended Spillway Design Flood (SDF) for the size (small, intermediate, or large) and hazard potential (low, significant, or high) classification of a dam is selected in accordance with the criceria. The SDF for those dams in the high hazard category varies between one-half of the Probable Maximum Flood (PMF) and the PMF. If the dam and spillway are not capable of passing the SDF without overtopping failure, the spillway capacity is rated as inadequate. If the dam and spillway are capable of passing one-half of the PMF without overtopping failure, or if the dam is not in the high hazard category, the spillway capacity is not rated as seriously inadequate. A spillway capacity is rated as seriously inadequate if all of the following conditions exist:

(a) There is a high hazard to loss of life from large flows downstream of the dam.

(b) Dam failure resulting from overtopping would significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure.

(c) The dam and spillway are not capable of passing one-half of the PMF without overtopping failure.

Description of Model:

If the Owner has not developed a PMF for the dam, the watershed is modeled with the HEC-1DB computer program, which was developed by the U.S. Army Corps of Engineers. The HEC-1DB computer program calculates a PMF runoff hydrograph (and percentages thereof) and routes the flows through both reservoirs and stream sections. In addition, it has the capability to simulate an overtopping dam failure. By modifying the rainfall criteria, it is also possible to model the 100-year flood with the program.

APPENDIX D

SUSQUEHANNA River Basin

Name of Stream: SPRING BROOK

Name of Dam: SPRING BROOK INTAKE

NDI ID No.: PA-00450

DER ID No.: 35-40

Latitude: N 41° 19' 50" Longitude: W 75° 41' 10"

Top of Dam Elevation: 922.1 ★

Streambed Elevation: 889.0 Height of Dam: 33 ft

Reservoir Storage at Top of Dam Elevation: 247★ acre-ft

Size Category: SMALL

Hazard Category: HIGH (see Section 5)

Spillway Design Flood: VARIES 1/2 PMF TO PMF

SELECT PMF

★ design VALUES

UPSTREAM DAMS

Name	Distance from Dam (miles)	Height (ft)	Storage at top of Dam Elevation (acre-ft)	Remarks
COMPTON	8.7	19	62	IGNORED † DER 35-132
★ WATRES	4.3	135	8,241	NDI PA-00451 DER 35-81
★ MAPLE LAKE †	5.3	23	1,151	NDI PA-00294 DER 35-42
★ NESBITT ✱	1.7	101	5,034	NDI PA-00449 DER 35-15

DOWNSTREAM DAMS

Name	Distance from Dam (miles)	Height (ft)	Storage at top of Dam Elevation (acre-ft)	Remarks
NONE				

✱ ALSO DER 35-95, UNNAMED, 5' HIGH, LESS THAN 1 M.G. - IGNORED †

† - IGNORED IN HYDROLOGIC ANALYSIS.

★ PHASE I REPORTS AVAILABLE.

Susquehanna River Basin

Name of Stream: Spring Brook

Name of Dam: Spring Brook Intake

DETERMINATION OF PMF RAINFALL & UNIT HYDROGRAPH

UNIT HYDROGRAPH DATA:

Sub-area	Drainage Area (square miles)	Cp (1)	Ct (2)	L miles (3)	L_{ca} miles (4)	L' miles (5)	Tp hours (6)	Map Area (7)	Plate (8)
W-1	15.07	0.62	1.50	7.52	3.39	N/A	3.97	11	E
N-1	10.31	0.62	1.50	6.856	3.636	N/A	3.94	11	E
N-2	10.75	0.62	1.50	7.71	4.924	N/A	4.47	11	E
S-1	6.18	0.62	1.50	7.235	3.788	N/A	4.05	11	E
Total	42.31								

(See Sketch on Sheet D-4)

(1) & (2): Snyder Unit Hydrograph coefficients supplied by Baltimore District, Corps of Engineers on maps and plates referenced in (7) & (8)

The following are measured from the outlet of the subarea:

(3): Length of main watercourse extended to divide

(4): Length of main watercourse to the centroid

The following is measured from the upstream end of the reservoir at normal pool:

(5): Length of main watercourse extended to divide

(6): $Tp = C_t \times (L \times L_{ca})^{0.3}$, except where the centroid of the subarea is located in the reservoir. Then $Tp = C_t \times (L')^{0.6}$

Initial flow is assumed at 1.5 cfs/sq. mile

Computer Data: QRCSN = -0.05 (5% of peak flow)
RTIOR = 2.0

RAINFALL DATA:

PMF Rainfall Index= 22.15 in., 24 hr., 200 sq. mile

	Hydromet. 40 (Susquehanna Basin)	Hydromet. 33 (Other Basins)
Zone:	N/A	N/A
Geographic Adjustment Factor:	97%	1.0
Revised Index Rainfall:	21.4	N/A

RAINFALL DISTRIBUTION (percent)

Time	Percent
6 hours	101
12 hours	111
24 hours	121
48 hours	128
72 hours	132
96 hours	N/A

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FOR ______
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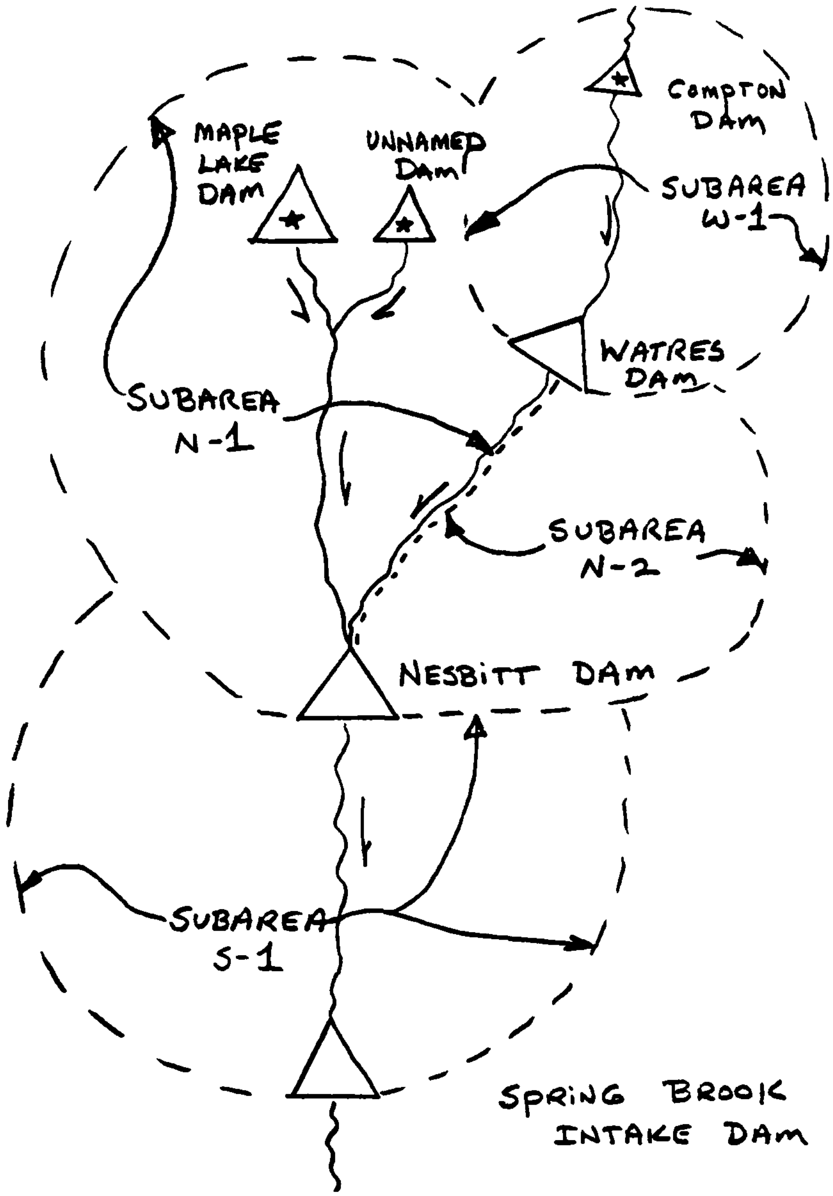


* NOT INCLUDED IN ANALYSIS

SKETCH OF SYSTEM

D-4

6313

Data for Dam at Outlet of Subarea W-1 (See sketch on Sheet D-4)

Name of Dam: WATRES

STORAGE DATA: DATA FROM PHASE I REPORT EXCEPT AS NOTED.

Elevation		Area (acres)		Storage million gals	Storage acre-ft		Remarks
1319.0	=ELEVO*	0		0	0		
1426.0	=ELEV1	167	=A1		5,957	=S1	
1438.9		261			8695	(1)	Existing Top
1440.0		270			8,987	(1)	Design Top
1460.0	**	361					

* ELEVO = ELEV1 - $(3S_1/A_1)$ (1) DIFFERS FROM PHASE I REPORT.

** Planimetered contour at least 10 feet above top of dam

Reservoir Area at Normal Pool is 2 percent of subarea watershed.

BREACH DATA:

See Appendix B for sections and existing profile of the dam.

Soil Type from Visual Inspection: ____

Maximum Permissible Velocity (Plate 28, EM 1110-2-1601) ____ fps (from $Q = CLH^{3/2} = V \cdot A$ and depth = (2/3) x H) & A = L·depth

HMAX = $(4/9\ V^2/C^2)$ = ____ ft., C = ____ Top of Dam El.= ____

HMAX + Top of Dam El. = ____ = FAILEL
(Above is elevation at which failure would start)

Dam Breach Data:

BRWID = ____ ft (width of bottom of breach)
Z = ____ (side slopes of breach)
ELBM = ____ (bottom of breach elevation, minimum of zero storage elevation)
WSEL = ____ (normal pool elevation)
T FAIL= ____ mins = ____ hrs (time for breach to develop)

Data for Dam at Outlet of Subarea W-1

Name of Dam: WATRES

SPILLWAY DATA:	Existing Conditions	Design Conditions
Top of Dam Elevation	1438.9	1440.0
Spillway Crest Elevation	1426.0	1426.0
Spillway Head Available (ft)	12.9	14.0
Type Spillway	BROAD-CRESTED	WEIR
"C" Value - Spillway	FROM RATING	CURVE
Crest Length - Spillway (ft)	72	72
Spillway Peak Discharge (cfs)	10,000	11,500
Auxiliary Spillway Crest Elev.	N/A	N/A
Auxiliary Spill. Head Avail. (ft)		
Type Auxiliary Spillway		
"C" Value - Auxiliary Spill. (ft)		
Crest Length - Auxil. Spill. (ft)		
Auxiliary Spillway Peak Discharge (cfs)	N/A	N/A
Combined Spillway Discharge (cfs)	10,000	11,500

Spillway Rating Curve: FROM PHASE I REPORT

Elevation	Q Spillway (cfs)	Q Auxiliary Spillway (cfs)	Combined (cfs)
1426.0	0	N/A	N/A
1429.0	1,300		
1431.0	2,500		
1433.0	3,750		
1436.0	6,500		
1438.9	10,000		
1440.0	11,500		
1450.0	25,820	(EXTRAPOLATED)	

OUTLET WORKS RATING:	Outlet 1	Outlet 2	Outlet 3
Invert of Outlet	NOT APPLICABLE	FOR	THIS REPORT
Invert of Inlet			
Type			
Diameter (ft) = D			
Length (ft) = L			
Area (sq. ft) = A			
N			
K Entrance			
K Exit			
K Friction $=29.1N^2L/R^{4/3}$			
Sum of K			
$(1/K)^{0.5} = C$			
Maximum Head (ft) = HM			
$Q = CA\sqrt{2g(HM)}$ (cfs)			
Q Combined (cfs)			

Data for Dam at Outlet of Subarea ~~N-2~~ N-1 (See sketch on Sheet D-4)

Name of Dam: NESBITT

STORAGE DATA: DATA FROM PHASE I REPORT EXCEPT AS NOTED.

Elevation	Area (acres)	Storage million gals	Storage acre-ft	Remarks
1056.8 =ELEVO*	0	0	0	
1156.0 =ELEV1	116 =A1		3,837 =S1	
1160.0	152			
1166.0	165		5,322 (1)	
1180.0 **	197			

* $ELEVO = ELEV1 - (3S_1/A_1)$ (1) DIFFERS FROM PHASE I REPORT

** Planimetered contour at least 10 feet above top of dam

Reservoir Area at Normal Pool is 1 percent of subarea(s) watershed.

BREACH DATA:

See Appendix B for sections and existing profile of the dam.

Soil Type from Visual Inspection: ______

Maximum Permissible Velocity (Plate 28, EM 1110-2-1601) ______ fps
(from $Q = CLH^{3/2} = V \cdot A$ and depth = (2/3) x H) & A = L·depth

HMAX = $(4/9\ V^2/C^2)$ = ______ ft., C = ____ Top of Dam El.= ____

HMAX + Top of Dam El. = ______ = FAILEL
(Above is elevation at which failure would start)

Dam Breach Data:

BRWID = ______ ft (width of bottom of breach)
Z = ______ (side slopes of breach)
ELBM = ______ (bottom of breach elevation, minimum of zero storage elevation)
WSEL = ______ (normal pool elevation)
T FAIL= ______ mins = ______ hrs (time for breach to develop)

Data for Dam at Outlet of Subareas N-1 & N-2

Name of Dam: NESBITT

SPILLWAY DATA:

	Existing Conditions	Design Conditions
Top of Dam Elevation	1166.0	SAME
Spillway Crest Elevation	1156.0	
Spillway Head Available (ft)	10	
Type Spillway	BROAD-CRESTED WITH ROUNDED NOSE	
"C" Value - Spillway	3.09	
Crest Length - Spillway (ft)	200.0	
Spillway Peak Discharge (cfs)	19,543	
Auxiliary Spillway Crest Elev.	N/A	
Auxiliary Spill. Head Avail. (ft)		
Type Auxiliary Spillway		
"C" Value - Auxiliary Spill. (ft)		
Crest Length - Auxil. Spill. (ft)		
Auxiliary Spillway Peak Discharge (cfs)	N/A	
Combined Spillway Discharge (cfs)	≈19,540	

Spillway Rating Curve: $Q = CLH^{3/2}$

Elevation	Q Spillway (cfs)	Q Auxiliary Spillway (cfs)	Combined (cfs)

OUTLET WORKS RATING:

	Outlet 1	Outlet 2	Outlet 3
Invert of Outlet	NOT APPLICABLE FOR THIS REPORT		
Invert of Inlet			
Type			
Diameter (ft) = D			
Length (ft) = L			
Area (sq. ft) = A			
N			
K Entrance			
K Exit			
K Friction $= 29.1N^2L/R^{4/3}$			
Sum of K			
$(1/K)^{0.5} = C$			
Maximum Head (ft) = HM			
$Q = CA\sqrt{2g(HM)}$ (cfs)			
Q Combined (cfs)			

Data for Dam at Outlet of Subarea S-1 (See sketch on Sheet D-4)

Name of Dam: Spring Brook Intake

STORAGE DATA:

Elevation	Area (acres)	Storage million gals	Storage acre-ft	Remarks
885.7 =ELEVO*	0	0	0	
910.0 =ELEV1	9.65 =A1	25.5	78.3 =S1	From Owner Data
920.0	17		210	
921.6	18		238	
922.1	18.4		247	
940.0 **	32			

* ELEVO = ELEV1 - $(3S_1/A_1)$

** Planimetered contour at least 10 feet above top of dam

Reservoir Area at Normal Pool is NEGL. percent of subarea watershed.

BREACH DATA: Not Used

See Appendix B for sections and existing profile of the dam.

Soil Type from Visual Inspection: ______

Maximum Permissible Velocity (Plate 28, EM 1110-2-1601) ______ fps (from $Q = CLH^{3/2} = V \cdot A$ and depth = (2/3) x H) & A = L·depth

HMAX = $(4/9\ V^2/C^2)$ = ______ ft., C = ____ Top of Dam El.= ____

HMAX + Top of Dam El. = ______ = FAILEL
(Above is elevation at which failure would start)

Dam Breach Data:

BRWID = ______ ft (width of bottom of breach)
Z = ______ (side slopes of breach)
ELBM = ______ (bottom of breach elevation, minimum of zero storage elevation)
WSEL = ______ (normal pool elevation)
T FAIL= ______ mins = ______ hrs (time for breach to develop)

Data for Dam at Outlet of Subarea S-1

Name of Dam: SPRING BROOK INTAKE

SPILLWAY DATA:

	Existing Conditions	Design Conditions
Top of Dam Elevation	921.6	922.1
Spillway Crest Elevation	910.0	910.0
Spillway Head Available (ft)	11.6	12.1
Type Spillway	BROAD-CRESTED WEIR/INCLINED CREST	
"C" Value - Spillway	3.1	3.1
Crest Length - Spillway (ft)	145	145
Spillway Peak Discharge (cfs)	17,760	18,920
Auxiliary Spillway Crest Elev.	910.0	910.0
Auxiliary Spill. Head Avail. (ft)	11.6	12.1
Type Auxiliary Spillway	BROAD-CRESTED WEIR/ROUNDED NOSE	
"C" Value - Auxiliary Spill. (ft)	3.88	3.88
Crest Length - Auxil. Spill. (ft)	67	67
Auxiliary Spillway Peak Discharge (cfs)	10,270	10,940
Combined Spillway Discharge (cfs)	28,030	29,860

Spillway Rating Curve: $Q = C' H^{1.5} \times (\Sigma L)$ $\quad \Sigma L = 212$ $\quad C' = \frac{3.1 \times 145 + 3.88 \times 67}{\Sigma L} = 3.347$

Elevation	Q Spillway (cfs)	Q Auxiliary Spillway (cfs)	Combined (cfs)

OUTLET WORKS RATING:

SEE FOLLOWING SHEETS

	Outlet 1	Outlet 2	Outlet 3
Invert of Outlet			
Invert of Inlet			
Type			
Diameter (ft) = D			
Length (ft) = L			
Area (sq. ft) = A			
N			
K Entrance			
K Exit			
K Friction $= 29.1 N^2 L / R^{4/3}$			
Sum of K			
$(1/K)^{0.5} = C$			
Maximum Head (ft) = HM			
$Q = CA\sqrt{2g(HM)}$ (cfs)			
Q Combined (cfs)			

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.
HARRISBURG, PA.

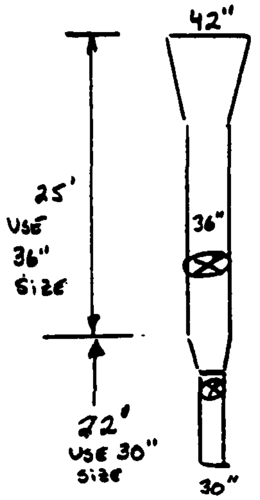
SUBJECT ______ FILE NO. ______
______ SHEET NO. ____ OF ____ SHEETS
FOR ______
COMPUTED BY ______ DATE ______ CHECKED BY ______ DATE ______

RIGHT OUTLET WORKS

$$K_{FRICTION} = \frac{29.1\, n^2 L}{R^{4/3}} \qquad R = \frac{\text{DIAMETER}}{4}$$

ALL K VALUES REFERENCED TO OUTLET

$$K_{AT\ OUTLET} = K_{point}\left(\frac{\text{AREA AT OUTLET}}{\text{AREA AT POINT}}\right)^2$$



		$K_{AT\ OUTLET}$
$K_e = 0.5$	$= 0.5$	.13
$K_c = 0.1\left(1 - \frac{36^2}{42^2}\right)$	$= .03$	.01
$K_f = \frac{29.1 \times .013^2 \times 25}{\left(\frac{36}{12\times4}\right)^{4/3}}$	$= .18$	.09
$K_{GATE} = .05$	$= .05$	.02
$K_c = 0.1\left(1 - \frac{30^2}{36^2}\right)$	$= .03$	.03
$K_{GATE} = .05$	$= .05$	.05
$K_f = \frac{29.1 \times .013^2 \times 22'}{\left(\frac{30}{12\times4}\right)^{4/3}}$	$= .20$	.20
K_{OUT}	$= 1.0$	1.0
		$\Sigma_K = 1.53$

$\Sigma L = 47'$

$$Q = A\sqrt{\frac{2gH}{\Sigma K}} = \left(\frac{30}{12}\right)^2 \times \frac{\pi}{4} \times \sqrt{\frac{64.36}{1.53}} \times \sqrt{H}$$

$$= 31.83\sqrt{H}$$

INVERT OUTLET 892.3

MAXIMUM POOL 922.1

$H \approx 28'$

$Q = 168$ CFS $\approx$ **170 CFS**

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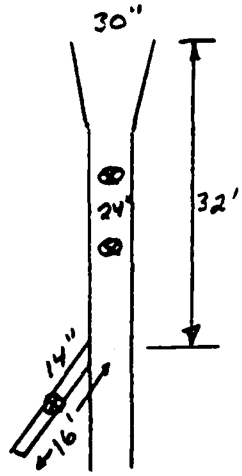
GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT ______ FILE NO. ______
______ SHEET NO. ____ OF ____ SHEETS
FOR ______
COMPUTED BY ______ DATE ______ CHECKED BY ______ DATE ______

LEFT OUTLET WORKS

(REFERENCE COMPUTATIONS ON PREVIOUS SHEET)



	K		$K_{AT\ OUTLET}$
$K_e = 0.5$		$= 0.5$	.02
$K_c = 0.1\left(1 - \frac{24^2}{30^2}\right)$		$= .04$	≈ 0
$K_{GATE} = 2 \times .05$		$= .01$	.01
$K_f = \dfrac{29.1 \times .013^2 \times 32}{\left(\frac{24}{12\times4}\right)^{4/3}}$		$= .40$	.05
$K_{TRANS} = 0.2\left(1 - \frac{14^2}{24^2}\right)$		$= .13$	.13
$K_{GATE} = 0.05$		$= 0.05$	.05
$K_f = \dfrac{29.1 \times .013^2 \times 16}{\left(\frac{14}{12\times4}\right)^{4/3}} =$			
K_{OUT}		$= 1.0$	1.0
		ΣK	1.26

$\Sigma L = 32' + 16'$
$= 48'$

$$Q = \left(\frac{14}{12}\right)^2 \times \pi/4 \times \sqrt{\frac{64.36}{1.26}} \times \sqrt{H}$$

$$= 7.64\sqrt{H}$$

INV EL = 891.4

$H \approx 30'$

$Q = 41.8$ CFS $\approx$ **40 CFS**

8313

SELECTED COMPUTER OUTPUT

6213

EXISTING

```
**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
 LAST MODIFICATION  17 JAN 80
**********************************
A1                      NATIONAL DAM INSPECTION PROGRAM
A2                                SPRING BROOK
A3                           SPRING BROOK INTAKE DAM
B     300       0      15       0       0       0       0       0      -4       0
B1      5
J       1       8       1
J1      1      .9      .8      .7      .6      .5      .4      .3
K       0       1                                       1
K1        RUNOFF SUBAREA W-1 (SPRING BROOK AT WATRES)
M       1       1   15.07           42.31                                   1
P            21.4     101     111     121     128     132
T                                                       1     .05                 .02
W    3.97    0.62
X    -1.5    -.05     2.0
K       1       1                                       1
K1        ROUTE THROUGH WATRES RESERVOIR
Y                                   1
Y1      1                                           -1426      -1
Y4   1426    1429    1431    1433    1436  1438.9    1440    1450
Y5      0    1300    2500    3750    6500   10000   11500   25820
$A      0     167     270     361
$E   1319    1426    1440    1460
$$   1426
$D1438.9
$L      1     600    1400    1400
$V1438.9    1440  1440.1    1460
K       1       2                                       1
K1        ROUTE FLOW FROM WATRES TO NESBITT
Y                                   1
Y1      1                                              -1
Y6    .09     .07     .09    1180    1220   11200    .013
Y7      0    1380     250    1300     500    1200     800    1180     840    1180
Y7    850    1200     900    1220    1200    1300
K       0       3                                       1
K1        RUNOFF FROM SUBAREA N-1 (RATTLESNAKE CREEK) INTO NESBITT
M       1       1   10.31           42.31                                   1
P            21.4     101     111     121     128     132
T                                                       1     .05
W    3.94     .62
X    -1.5    -.05     2.0
K       0       3                                       1
K1        RUNOFF FROM SUBAREA N-2 (SPRING BROOK SUBAREA) INTO NESBITT
M       1       1   10.75           42.31                                   1
P            21.4     101     111     121     128     132
T                                                       1     .05                 .01
W    4.47     .62
X    -1.5    -.05     2.0
K       3       3                                       1
K1        COMBINE WATRES OUTFLOW WITH N-1 + N-2 INFLOWS
K       1       3                                       1
```

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```
K1      ROUTE THROUGH NESBITT DAM
Y                                1
Y1     1                                                -1156
SA     0     116     152     197
SE1056.8    1156    1160    1180
SS  1156     200    3.09     1.5
SD  1166
SL 355.5     360
SV  1166    1180
K      1       4                                            1
K1      ROUTE  STREAM X-SECT
Y                                1
Y1     1                                                   -1
Y6   .09     .07     .09    1054    1084    1600    .0167
Y7     0    1120     150    1080     450    1060     600    1054     650    1054
Y7   700    1080     750    1100     900    1160
K      1       5                                            1
K1      ROUTE  STREAM X-SECT
Y                                1
Y1     1                                                   -1
Y6   .09     .07     .09    1023    1053    2000     .02
Y7     0    1200     150    1100     250    1040     340    1023     380    1023
Y7   390    1040     650    1100    1000    1200
K      1       6                                            1
K1      ROUTE STREAM X-SECT
Y                                1
Y1     1                                                   -1
Y6   .09     .07     .09     966    1000    7500    .011
Y7     0    1100     390    1000     490     980     900     966     940     966
Y7   990     980    1020    1000    1520    1100
K      0       7                                            1
K1      UNCONTROLLED RUNOFF INTO SPRING BROOK INTAKE (SUBAREA S-1)
M      1       1    6.18           42.31                                    1
P           21.4     101     111     121     128     132
T                                                           1     .05
W   4.05     .62
X   -1.5    -.05     2.0
K      2       7                                            1
K1      COMBINE INFLOWS TO SPRING BROOK INTAKE
K      1       7                                            1
K1      ROUTE THROUGH SPRING BROOK INTAKE
Y                                1
Y1     1                                                 -910
SA     0    9.65      17      32
SE 885.7     910     920     940
SS   910     212   3.347     1.5
SD 921.6
SL     1      15      49      83      89
SV 921.6   921.9   922.6   924.1   929.1
K     99
```

D-15

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO 1 1.00	RATIO 2 .90	RATIO 3 .80	RATIO 4 .70	RATIO 5 .60	RATIO 6 .50	RATIO 7 .40	RATIO 8 .30
				RATIOS APPLIED TO FLOWS							
HYDROGRAPH AT	1	15.07	1	23544.	21190.	18835.	16481.	14127.	11772.	9418.	7063.
	(	39.03)	(	666.70)(	600.03)(	533.36)(	466.69)(	400.02)(	333.35)(	266.68)(	200.01)(
ROUTED TO	1	15.07	1	23063.	20414.	17488.	14159.	10870.	8814.	6806.	4939.
	(	39.03)	(	653.06)(	578.05)(	495.22)(	400.93)(	307.81)(	249.57)(	192.71)(	139.87)(
ROUTED TO	2	15.07	1	22875.	20167.	17281.	13977.	10821.	8773.	6775.	4916.
	(	39.03)	(	647.75)(	571.05)(	489.33)(	395.80)(	306.41)(	248.42)(	191.86)(	139.21)(
HYDROGRAPH AT	3	10.31	1	16271.	14644.	13017.	11390.	9763.	8136.	6508.	4881.
	(	26.70)	(	460.75)(	414.67)(	368.60)(	322.52)(	276.45)(	230.37)(	184.30)(	138.22)(
HYDROGRAPH AT	3	10.75	1	15552.	13996.	12441.	10886.	9331.	7776.	6221.	4665.
	(	27.84)	(	440.37)(	396.34)(	352.30)(	308.26)(	264.22)(	220.19)(	176.15)(	132.11)(
3 COMBINED	3	36.13	1	54039.	47822.	41164.	33776.	27840.	22936.	17995.	13221.
	(	93.58)	(	1530.20)(	1354.17)(	1165.63)(	956.43)(	788.35)(	649.48)(	509.57)(	374.36)(
ROUTED TO	3	36.13	1	53482.	47244.	40602.	33487.	27545.	22548.	17475.	12810.
	(	93.58)	(	1514.43)(	1337.81)(	1149.72)(	948.24)(	779.97)(	638.49)(	494.83)(	362.74)(
ROUTED TO	4	36.13	1	53473.	47263.	40625.	33500.	27553.	22539.	17475.	12806.
	(	93.58)	(	1514.19)(	1338.35)(	1150.38)(	948.60)(	780.21)(	638.24)(	494.83)(	362.62)(
ROUTED TO	5	36.13	1	53459.	47266.	40636.	33511.	27552.	22532.	17473.	12805.
	(	93.58)	(	1513.79)(	1338.43)(	1150.69)(	948.92)(	780.20)(	638.04)(	494.77)(	362.61)(
ROUTED TO	6	36.13	1	53366.	47097.	40524.	33417.	27490.	22478.	17438.	12773.
	(	93.58)	(	1511.17)(	1333.63)(	1147.51)(	946.26)(	778.42)(	636.50)(	493.79)(	361.68)(
HYDROGRAPH AT	7	6.18	1	9477.	8529.	7581.	6634.	5686.	4738.	3791.	2843.
	(	16.01)	(	268.35)(	241.52)(	214.68)(	187.85)(	161.01)(	134.18)(	107.34)(	80.51)(
2 COMBINED	7	42.31	1	62190.	54953.	47243.	39051.	32518.	26515.	20599.	15107.
	(	109.58)	(	1761.04)(	1556.10)(	1337.76)(	1105.79)(	920.81)(	750.82)(	583.29)(	427.79)(
ROUTED TO	7	42.31	1	62163.	54912.	47229.	39063.	32528.	26519.	20598.	15099.
	(	109.58)	(	1760.25)(	1554.92)(	1337.39)(	1106.14)(	921.10)(	750.94)(	583.28)(	427.55)(

SUMMARY OF DAM SAFETY ANALYSIS

WATRES

PLAN 1 ....

	INITIAL VALUF	SPILLWAY CREST	TOP OF DAM
ELEVATION	1426.00	1426.00	1438.90
STORAGE	5956.	5956.	8695.
OUTFLOW	0.	0.	10000.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1441.47	2.57	9387.	23063.	7.25	44.00	0.00
.90	1441.18	2.28	9309.	20414.	6.50	44.00	0.00
.80	1440.84	1.94	9215.	17488.	5.50	44.25	0.00
.70	1440.38	1.48	9089.	14159.	4.50	44.75	0.00
.60	1439.44	.54	8837.	10870.	2.50	45.50	0.00
.50	1437.92	0.00	8442.	8814.	0.00	45.50	0.00
.40	1436.25	0.00	8032.	6806.	0.00	45.75	0.00
.30	1434.30	0.00	7577.	4939.	0.00	45.75	0.00

PLAN 1 STATION 2

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	22875.	1194.9	44.25
.90	20167.	1194.0	44.50
.80	17281.	1193.1	44.75
.70	13977.	1192.0	45.25
.60	10821.	1190.7	45.75
.50	8773.	1189.7	45.75
.40	6775.	1188.7	46.00
.30	4916.	1187.4	46.25

SUMMAPY OF DAM SAFETY ANALYSIS

NESBITT

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1156.00	1156.00	1166.00
STORAGE	3836.	3836.	5321.
OUTFLOW	0.	0.	19543.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVEP TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1171.71	5.71	6298.	53482.	9.25	44.25	0.00
.90	1170.87	4.87	6149.	47244.	8.50	44.50	0.00
.80	1169.92	3.92	5983.	40602.	7.50	44.75	0.00
.70	1168.81	2.81	5792.	33487.	6.50	45.00	0.00
.60	1167.77	1.77	5616.	27545.	5.25	44.75	0.00
.50	1166.76	.76	5447.	22548.	3.25	44.75	0.00
.40	1165.28	0.00	5203.	17475.	0.00	45.00	0.00
.30	1163.55	0.00	4922.	12810.	0.00	45.00	0.00

PLAN 1 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	53473.	1070.5	44.25
.90	47263.	1069.6	44.50
.80	40625.	1068.6	44.75
.70	33500.	1067.3	45.00
.60	27553.	1066.2	44.75
.50	22539.	1065.1	44.75
.40	17475.	1063.9	45.00
.30	12806.	1062.7	45.00

PLAN 1 STATION 5

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	53459.	1047.7	44.25
.90	47266.	1046.4	44.50
.80	40636.	1045.0	44.75
.70	33511.	1043.3	45.00
.60	27552.	1041.7	44.75
.50	22532.	1040.3	44.75
.40	17473.	1038.4	45.00
.30	12805.	1036.2	45.25

PLAN 1 STATION 6

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	53366.	982.6	44.50
.90	47097.	981.9	44.50

.80	40524.	981.1	44.75
.70	33417.	980.1	45.00
.60	27490.	979.0	45.00
.50	22478.	978.0	45.00
.40	17438.	976.9	45.25
.30	12773.	975.5	45.50

SUMMARY OF DAM SAFETY ANALYSIS

SPRING BROOK INTAKE

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	910.00	910.00	921.60
STORAGE	78.	78.	238.
OUTFLOW	0.	0.	28034.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	928.85	7.25	386.	62163.	7.50	44.50	0.00
.90	927.53	5.93	356.	54912.	6.75	44.50	0.00
.80	926.04	4.44	324.	47229.	5.75	44.75	0.00
.70	924.32	2.72	289.	39063.	5.00	45.00	0.00
.60	922.79	1.19	260.	32528.	3.25	44.75	0.00
.50	921.18	0.00	230.	26519.	0.00	45.00	0.00
.40	919.45	0.00	200.	20598.	0.00	45.00	0.00
.30	917.68	0.00	172.	15099.	0.00	45.00	0.00

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT ______ FILE NO. ______
______ SHEET NO. ____ OF ____ SHEETS
FOR ______
COMPUTED BY ______ DATE ______ CHECKED BY ______ DATE ______

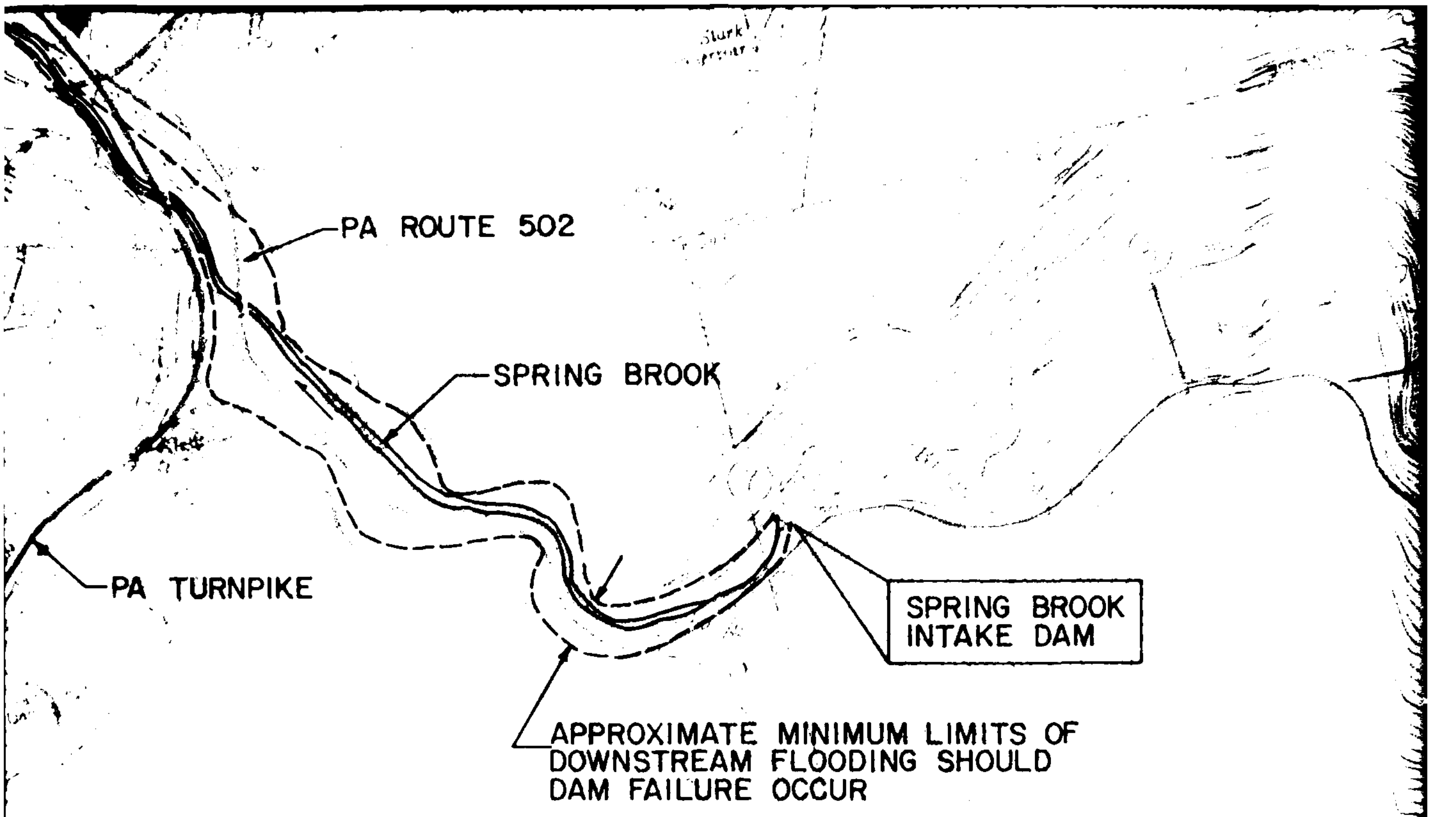
SUMMARY OF PERTINENT RESULTS

PMF RAINFALL = 23.87"

AT SPRING BROOK INTAKE DAM:

	PMF	1/2 PMF
RUNOFF (INCHES)	21.14	10.57
PEAK INFLOW (CFS)	62,190	26,515
PEAK OUTFLOW (CFS)	62,163	26,519
DEPTH OF OVERTOPPING (FT)	7.25	–
DURATION OF OVERTOPPING (HR)	7.50	–
FREEBOARD (FT)	–	0.42

8313

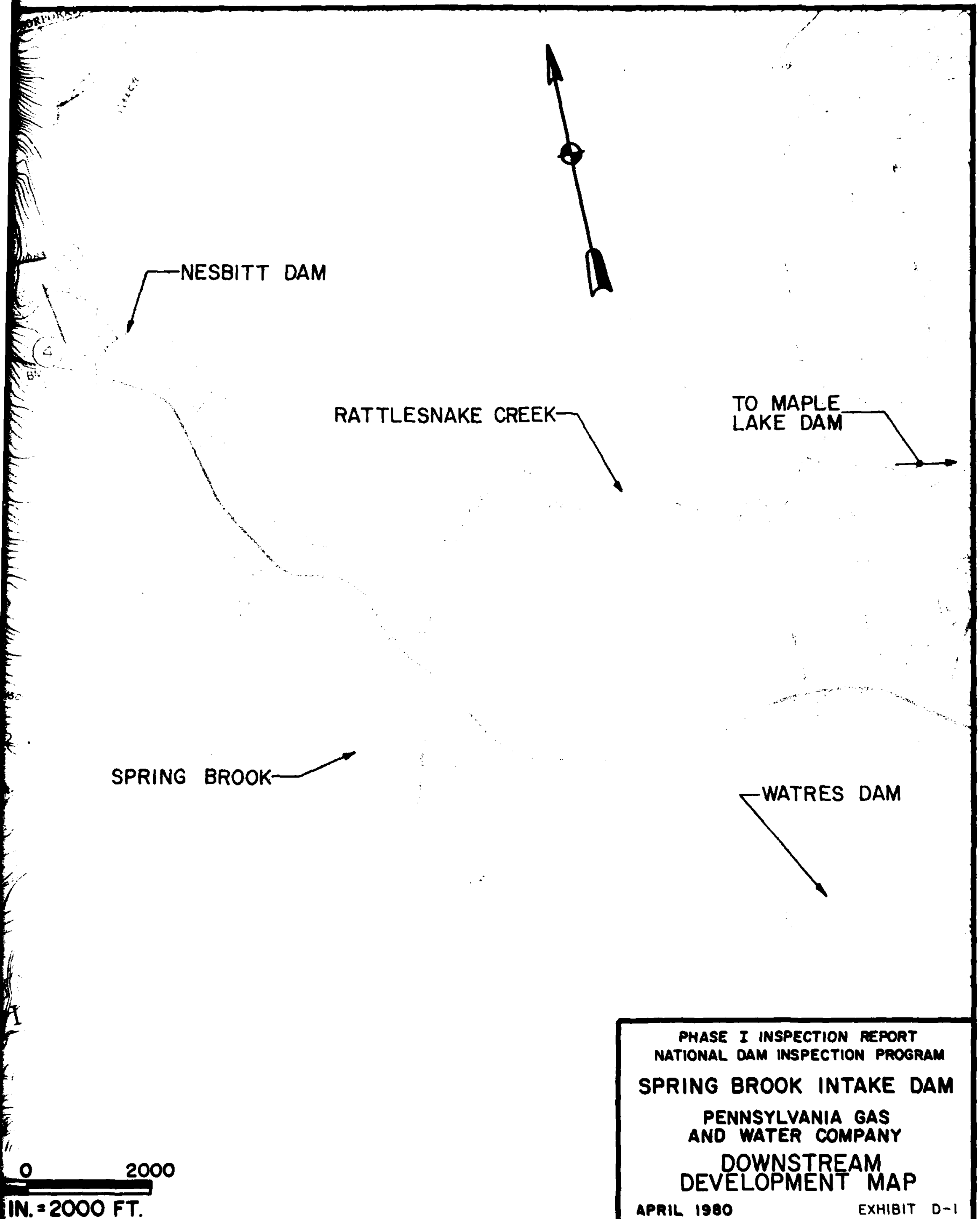


NOTES:

1. LIMITS OF DOWNSTREAM FLOODING ARE ESTIMATES BASED ON VISUAL OBSERVATION.
2. CIRCLED NUMBERS INDICATE STATIONS USED IN COMPUTER ANALYSIS.
3. FLOODED AREA SHOWN ASSUMES DAMS UPSTREAM OF SPRING BROOK INTAKE DAM REMAIN INTACT.
4. THIS MAP SHOULD NOT BE USED IN CONNECTION WITH THE EMERGENCY OPERATION AND WARNING PLAN.

2000

SCALE: 1



PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

SPRING BROOK INTAKE DAM

PENNSYLVANIA GAS AND WATER COMPANY

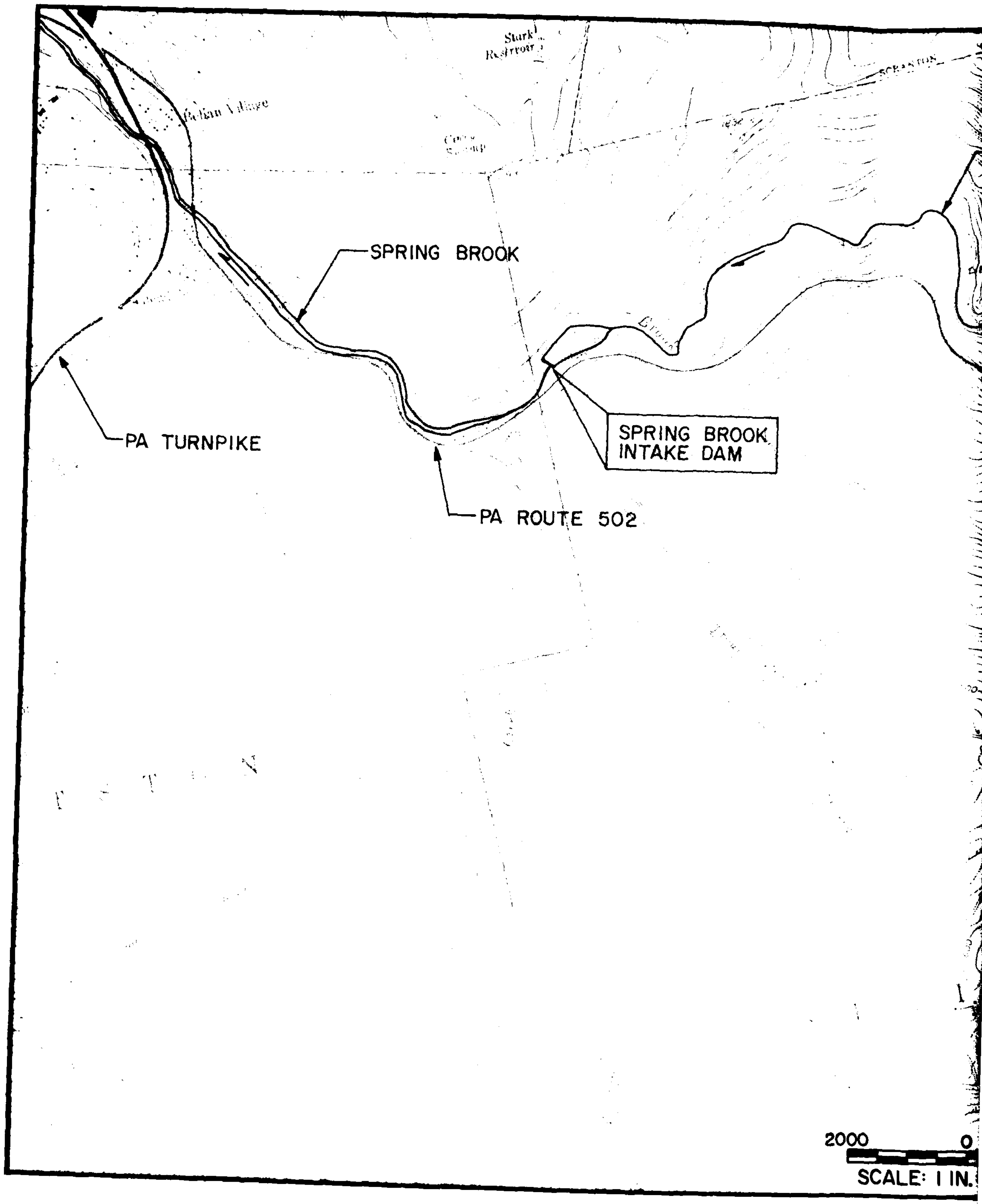
DOWNSTREAM DEVELOPMENT MAP

APRIL 1980

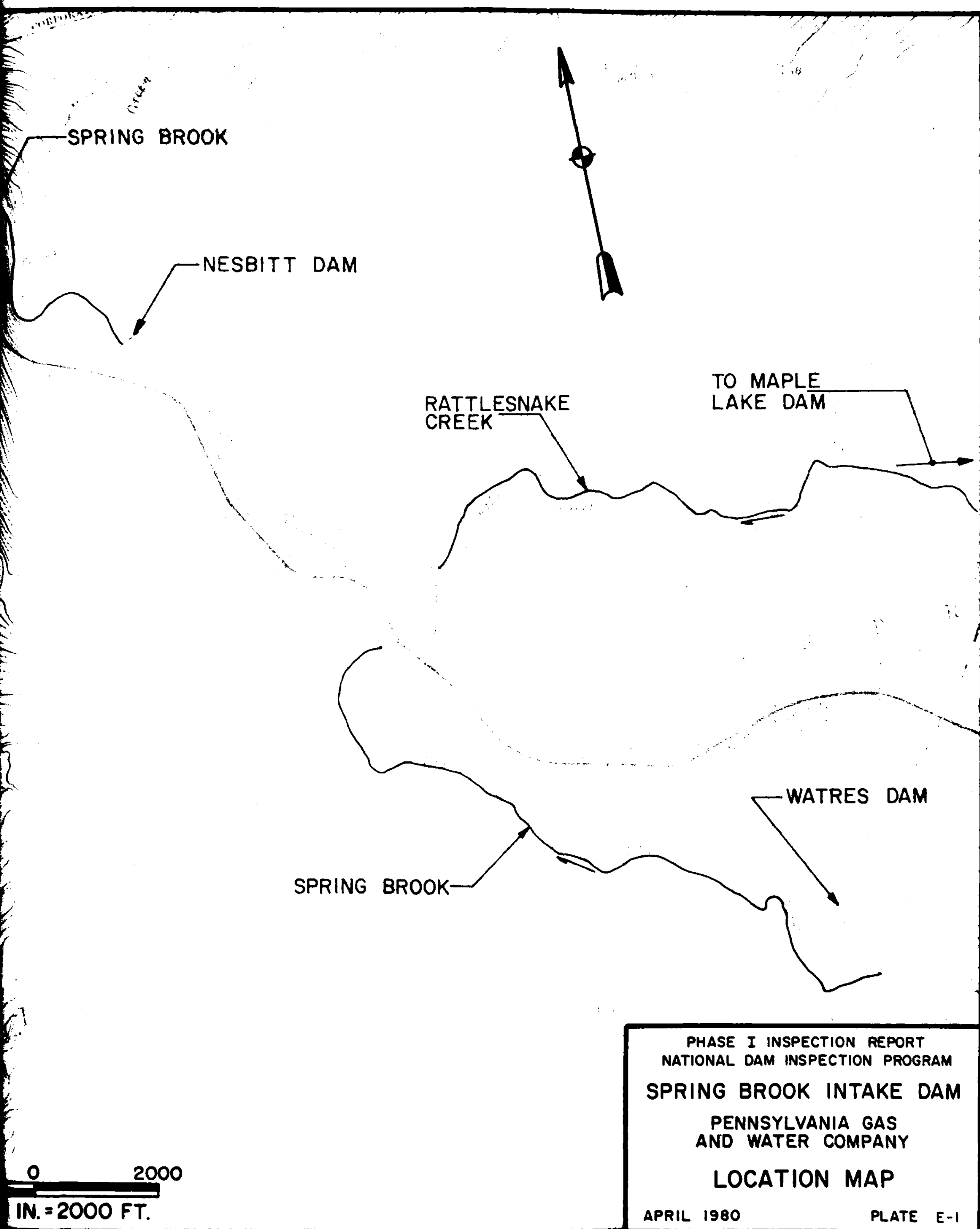
EXHIBIT D-1

APPENDIX E

PLATES



Stark Reservoir
Pelham Village
SCRANTON
SPRING BROOK
PA TURNPIKE
SPRING BROOK INTAKE DAM
PA ROUTE 502
2000
0
SCALE: 1 IN.



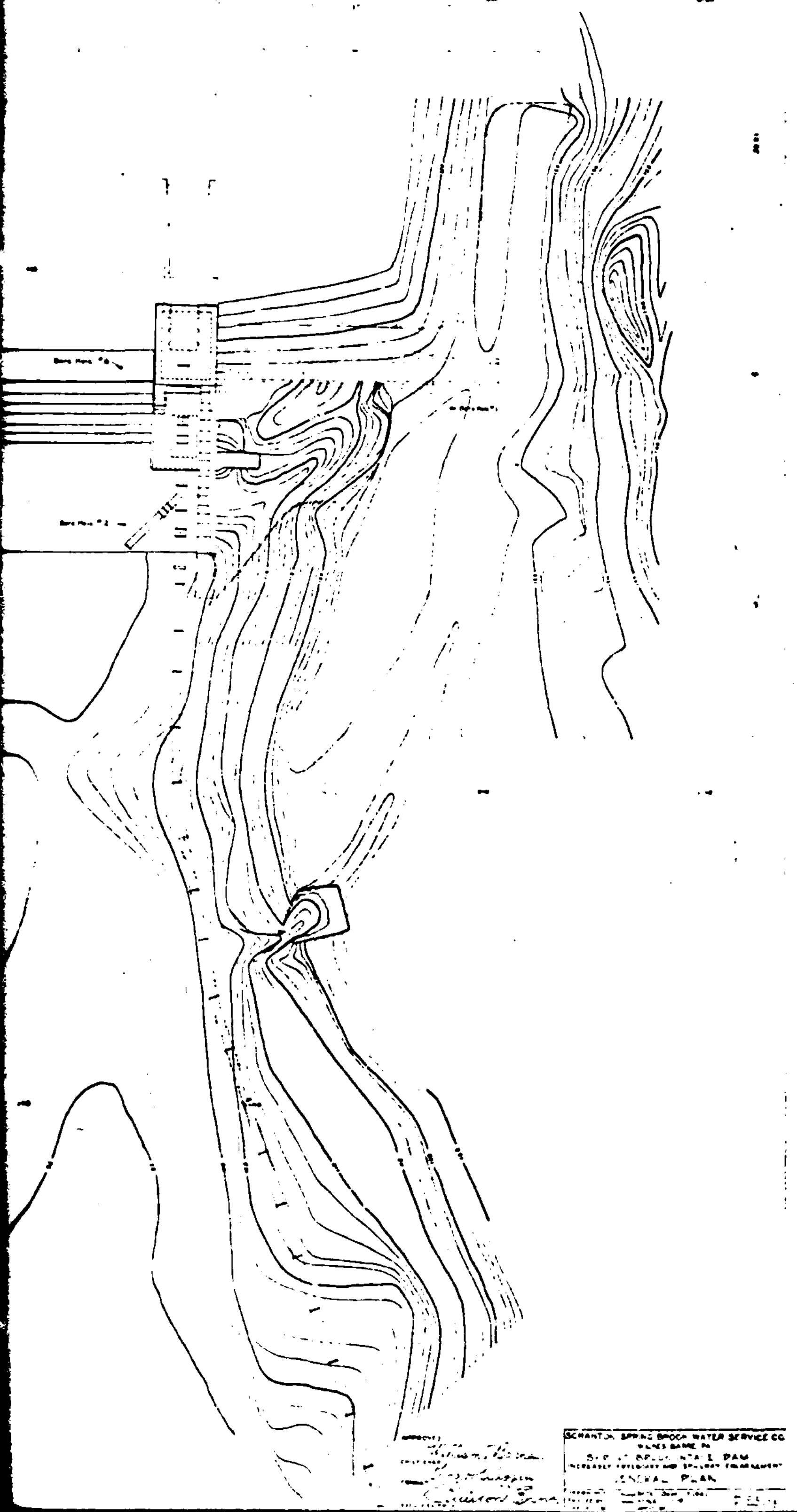
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

SPRING BROOK INTAKE DAM

PENNSYLVANIA GAS
AND WATER COMPANY

LOCATION MAP

APRIL 1980 PLATE E-1



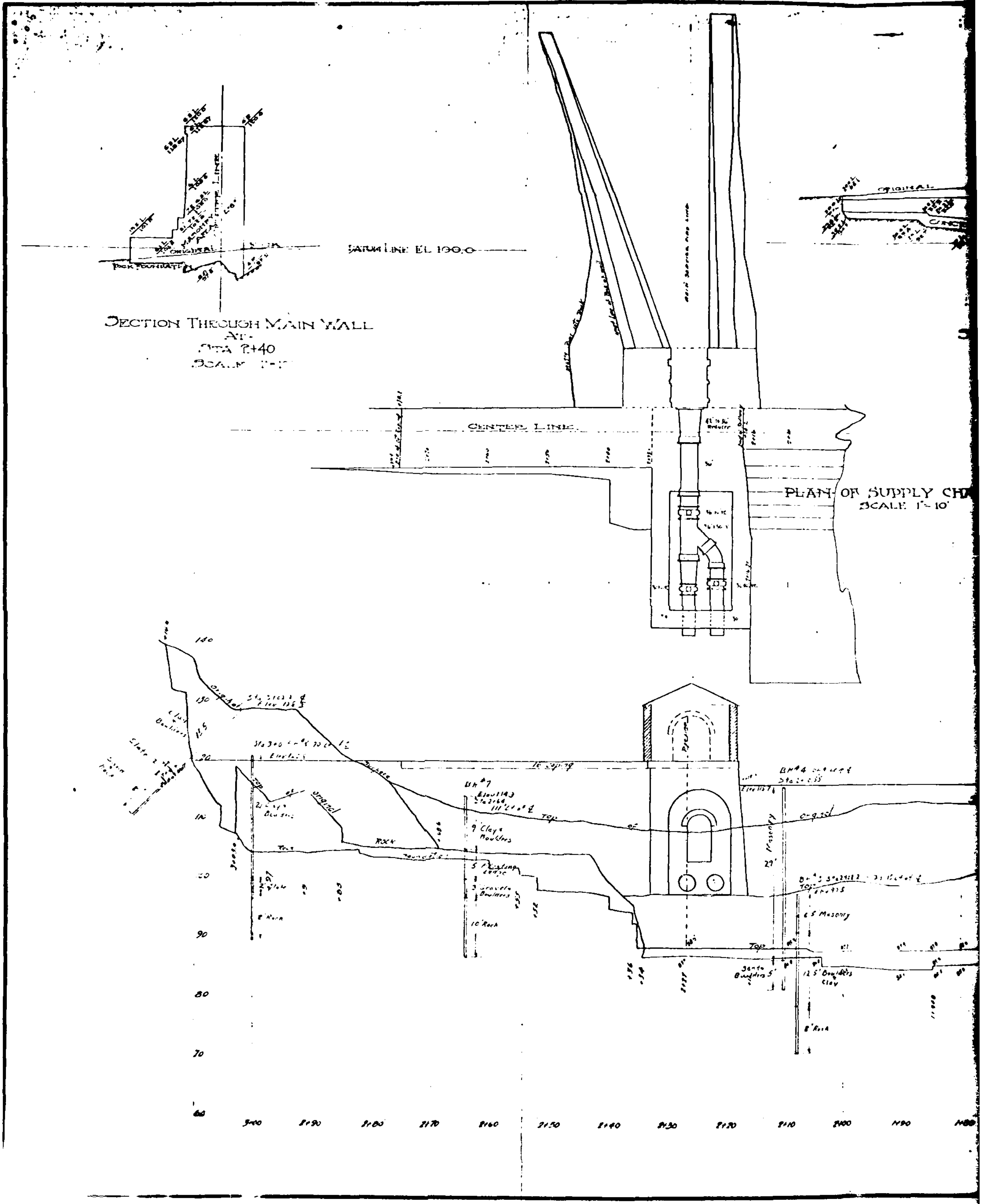
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

SPRING BROOK INTAKE DAM

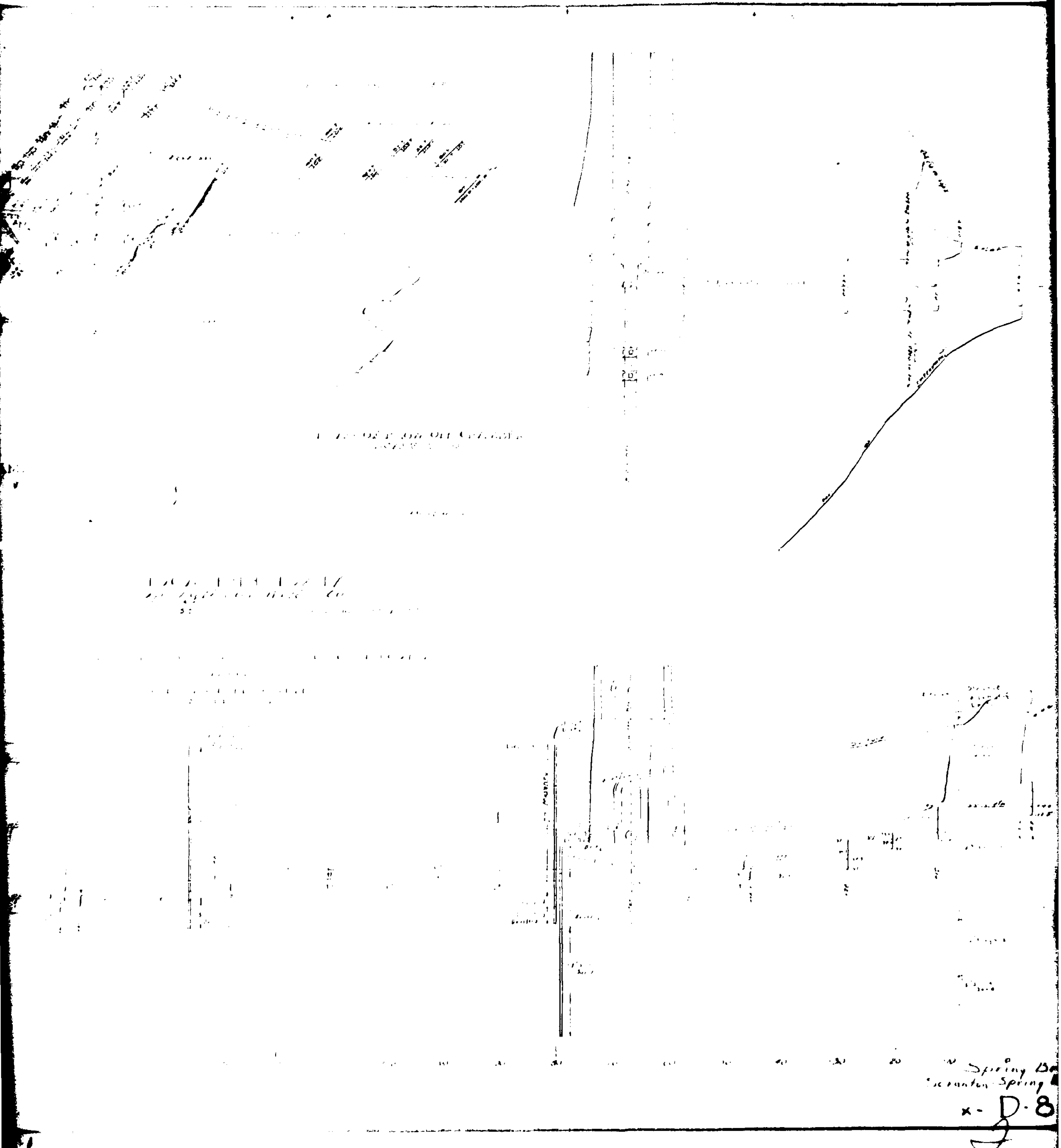
PENNSYLVANIA GAS
AND WATER COMPANY

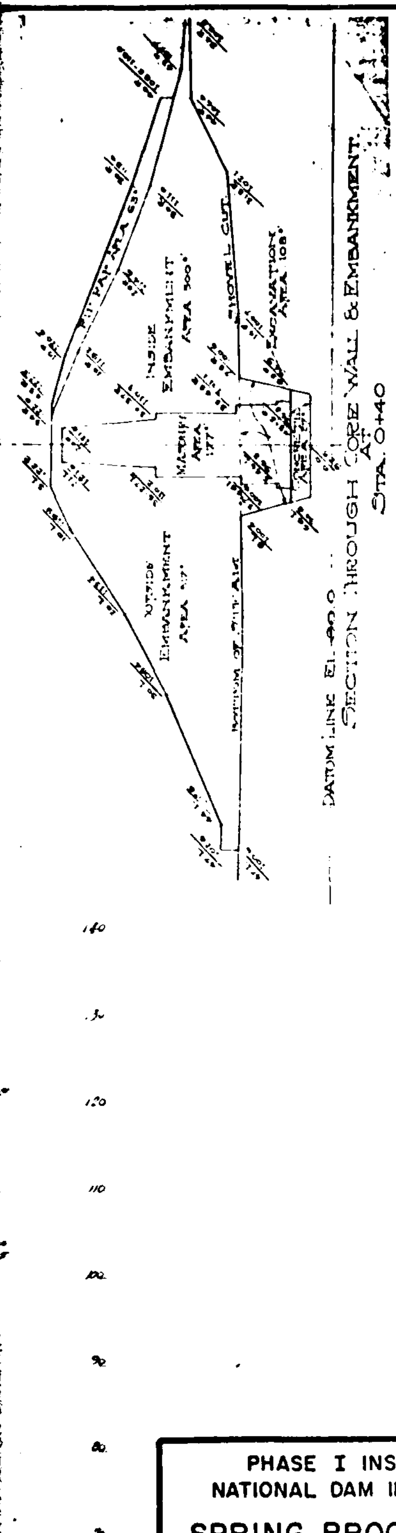
PLAN

APRIL 1980 PLATE E-2



SECTION THROUGH MAIN WALL
AT
STA 2+40
DATUM LINE EL 100.0
CENTER LINE
PLAN OF SUPPLY CH
SCALE 1"=10'
140
130
120
110
100
90
80
70
60
2100
2190
2180
2170
2160
2150
2140
2130
2120
2110
2100
1190


Spring B
Scranton Spring
x - D-8



PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

SPRING BROOK INTAKE DAM

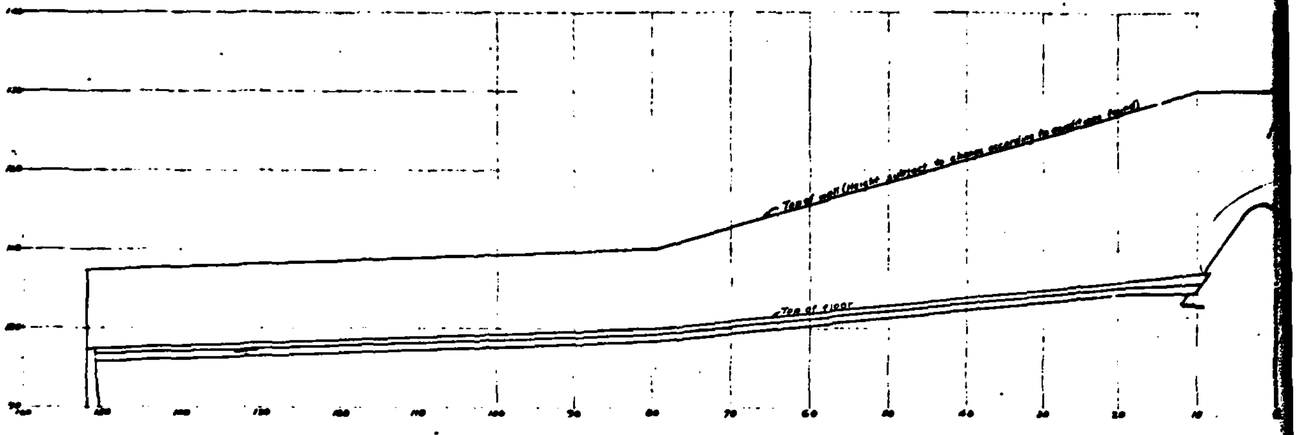
PENNSYLVANIA GAS
AND WATER COMPANY

PROFILE AND
MAIN SPILLWAY

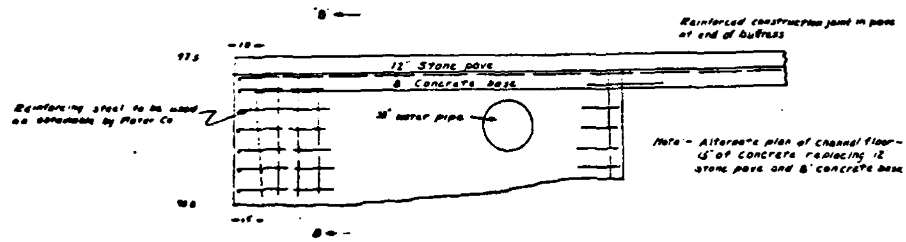
APRIL 1980 PLATE E-3

51-a

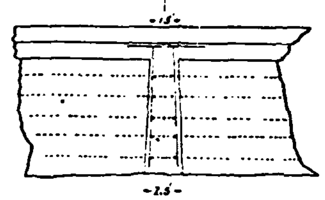
3



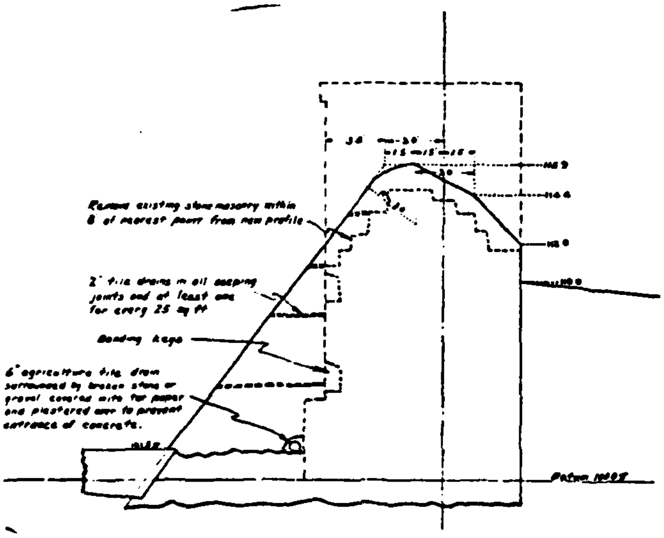
PROFILE ALONG CHANNEL WALL
SCALE 1"=10' HOR. & VERT



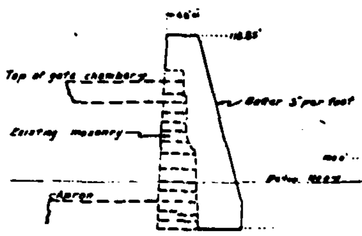
SECTION OF CURTAIN WALL & BUTTRESS
SCALE 1"=4'



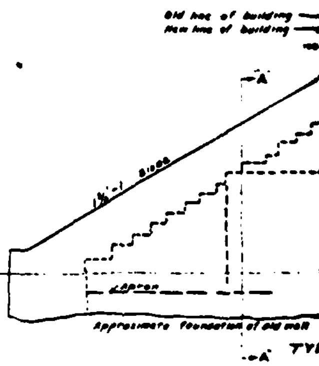
BUTTRESS SECTION "B-B"
SCALE 1"=4'



TYPICAL SECTION OF SPILLWAY
SCALE 1"=4'



WINGWALL SECTION "A-A"
SCALE 1"=10'



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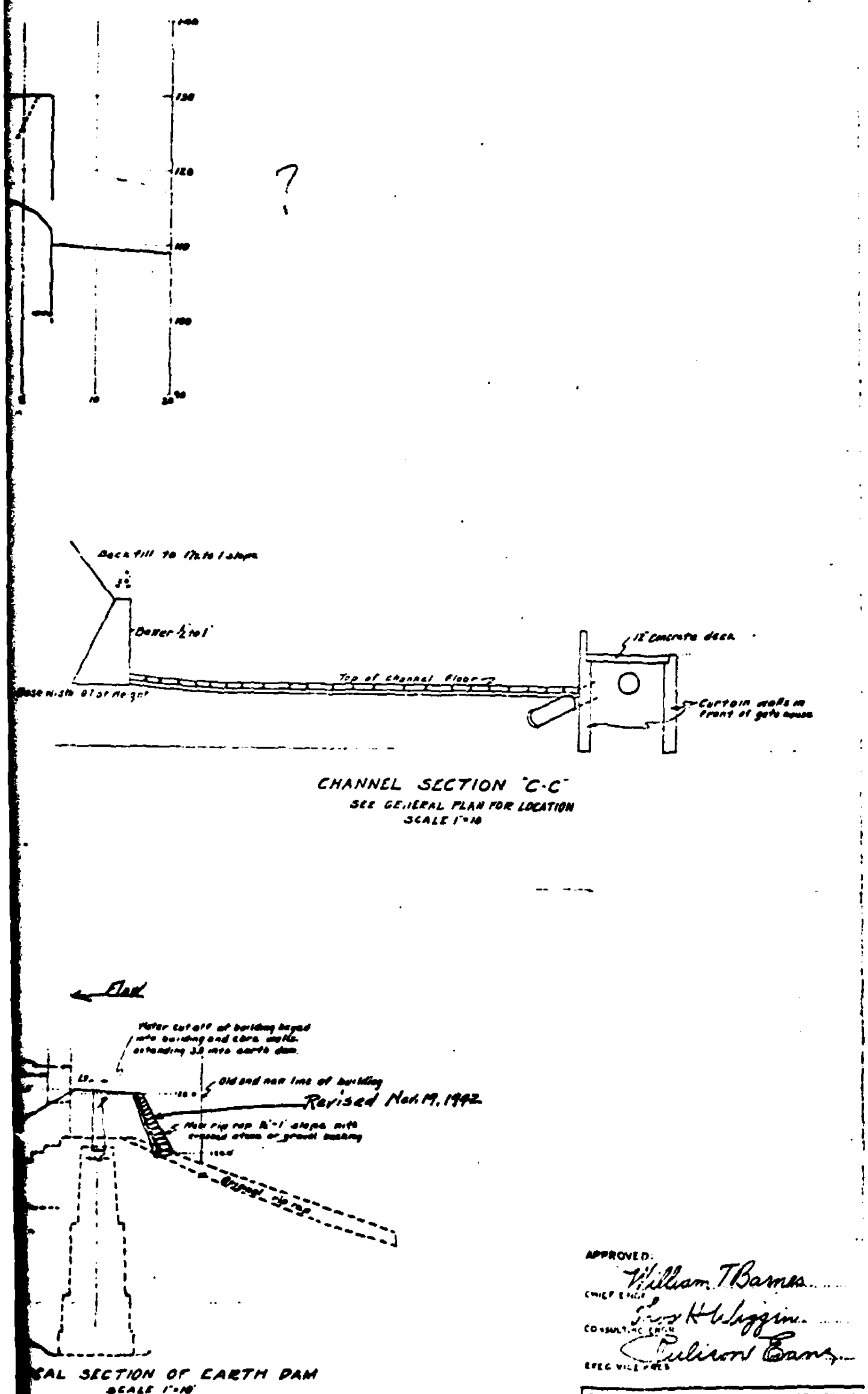


APPROVED:
William T Barnes
CHIEF ENGR.
CONSULTING ENGR.
EXEC. VICE PRES.

SCRANTON-SPRING BROOK WATER SERVICE CO.
WILKES BARRE, PA

SPRING BROOK INTAKE DAM
INCREASED FREEBOARD AND SPILLWAY ENLARGEMENT
DETAILS OF DAM AND SPILLWAY CHANNEL

D-851-h

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

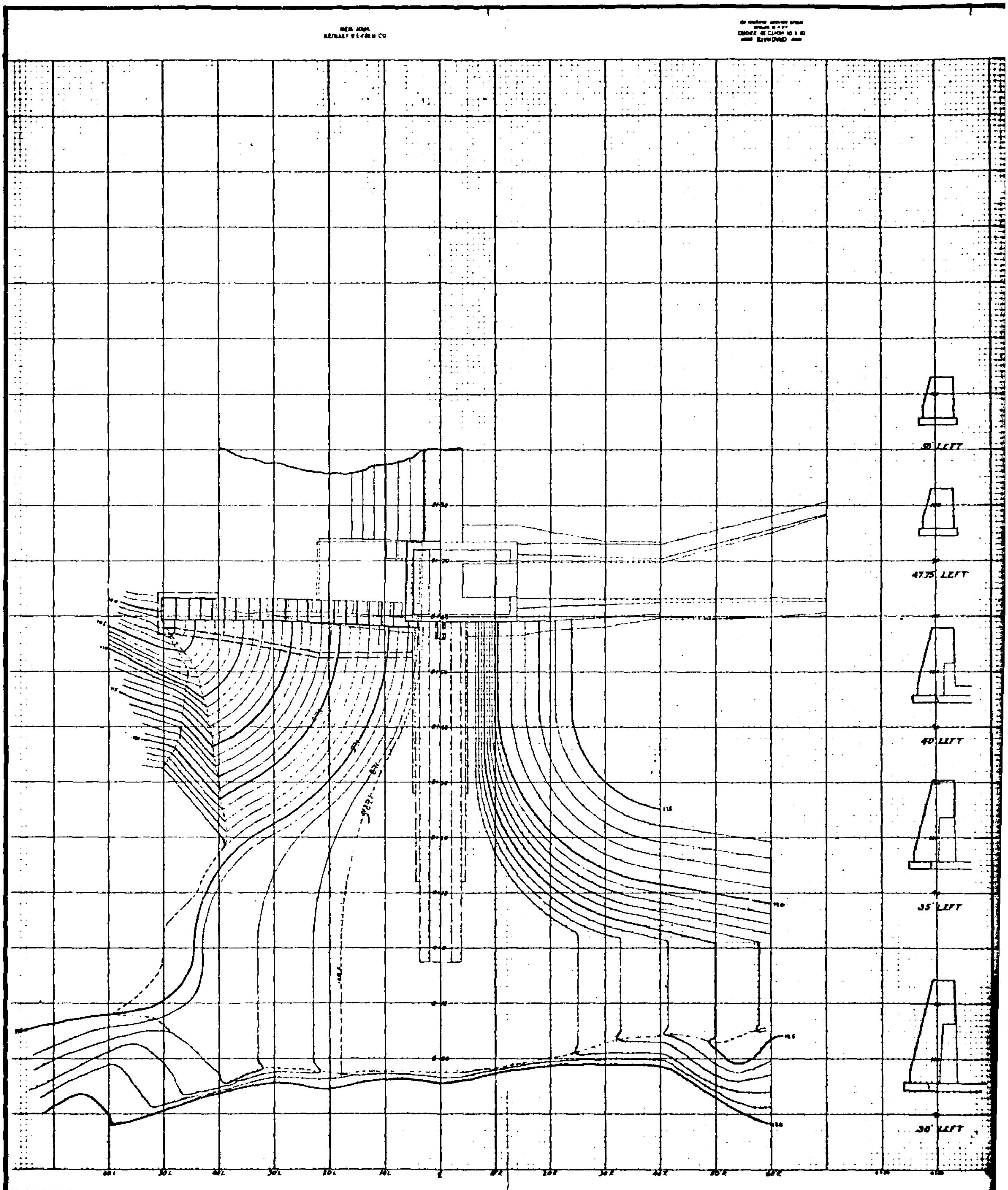
SPRING BROOK INTAKE DAM

PENNSYLVANIA GAS
AND WATER COMPANY

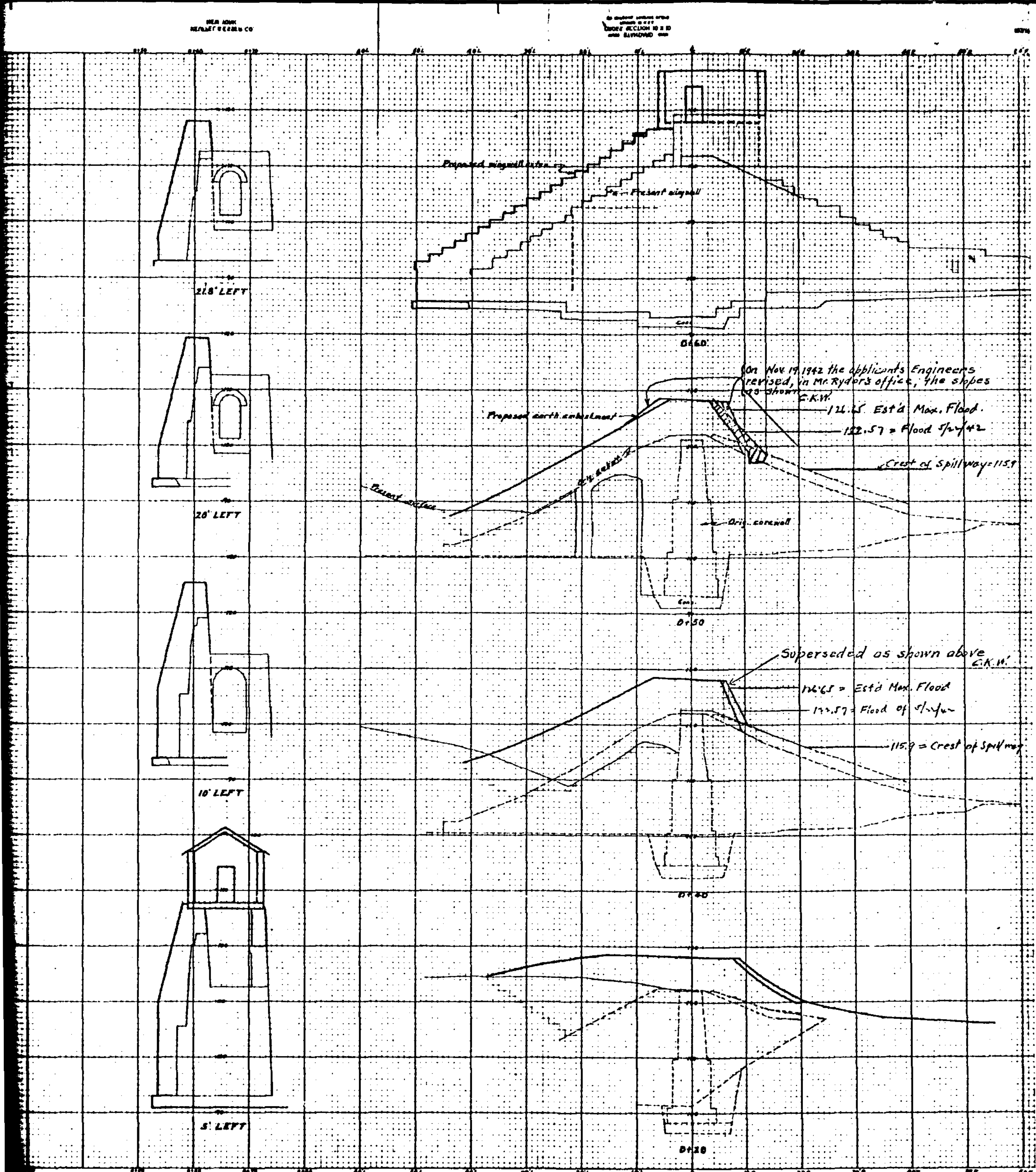
AUXILIARY SPILLWAY

APRIL 1980

PLATE E-4



50' LEFT
47.75' LEFT
40' LEFT
35' LEFT
30' LEFT



PH
NATIO
SPRIN
A
APRIL

PHASE I INSPECTION REPORT
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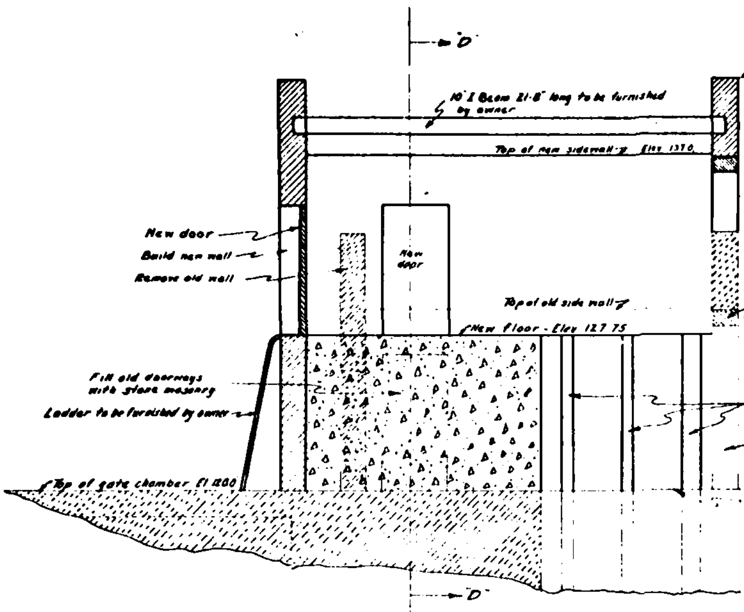
ING BROOK INTAKE DAM

PENNSYLVANIA GAS
AND WATER COMPANY

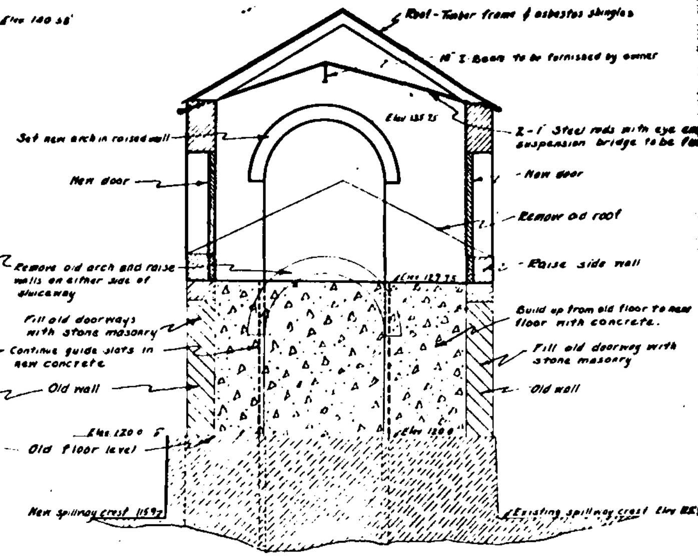
EMBANKMENT

1980 PLATE E-5

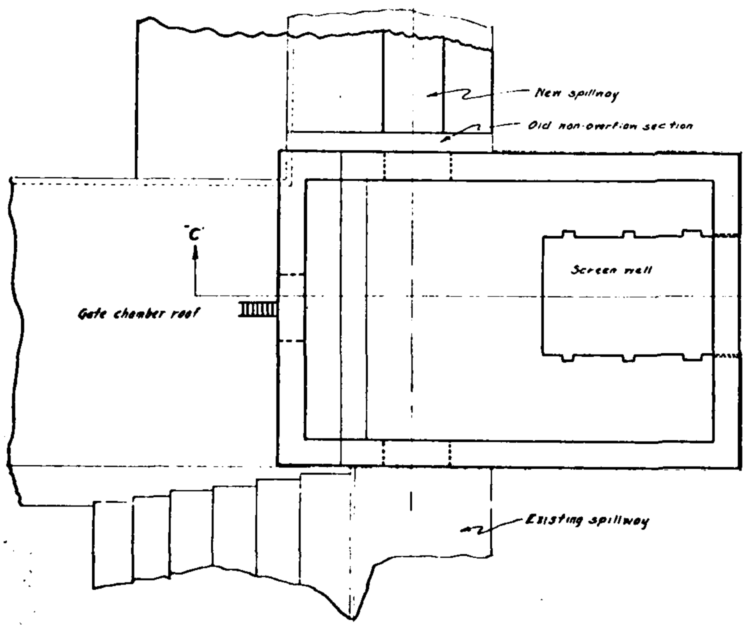
3



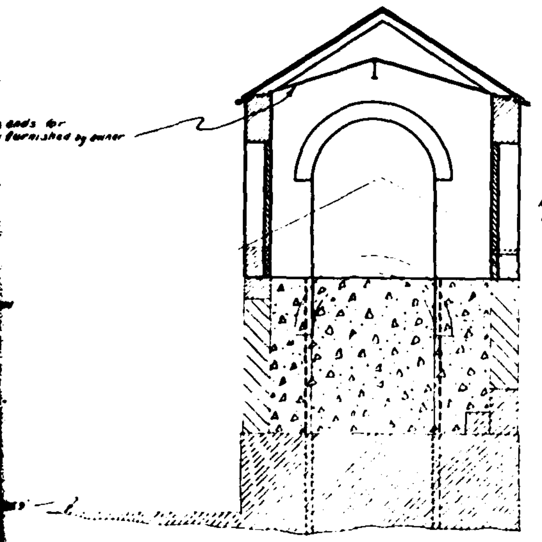
NORTH SCREEN HOUSE - SECTION "C-C"



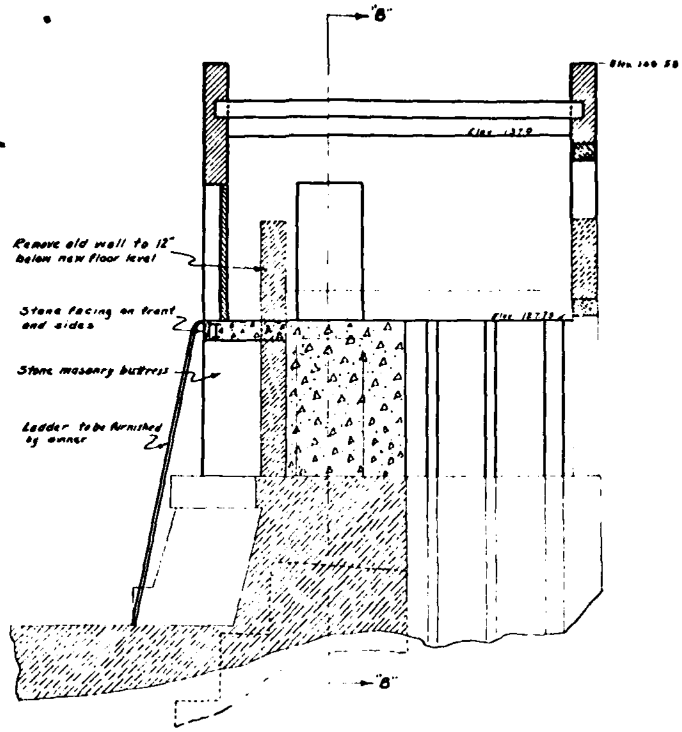
NORTH SCREEN HOUSE - SECTION "D-D"



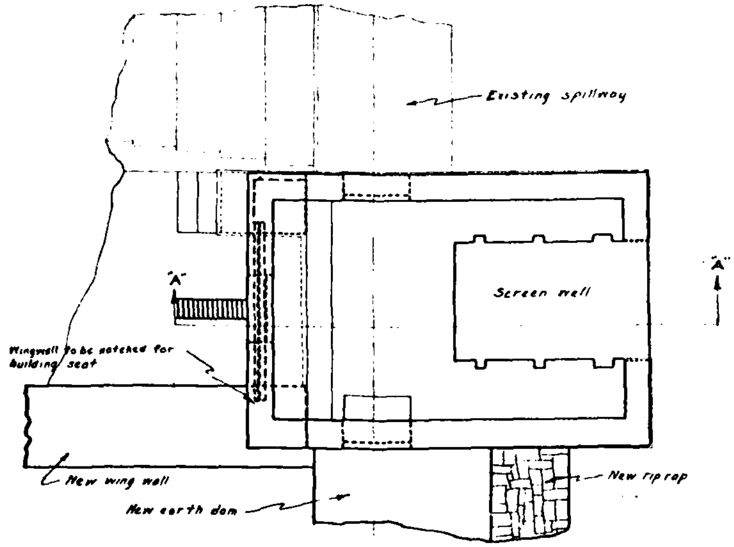
NORTH SCREEN HOUSE - PLAN (ROOF REMOVED)



SOUTH SCREEN HOUSE
SECTION B-B



SOUTH SCREEN HOUSE - SECTION A-A



SOUTH SCREEN HOUSE
PLAN (ROOF REMOVED)

APPROVED:
William T. Barnes
CHIEF ENGR.
Thos. H. Wiggin
CONSULTING ENGR.
Dulison Evans
EXEC. VICE PRES.

SCRANTON-SPRING BROOK WATER SERVICE CO.
WILKES BARRE, PA
SPRING BROOK INTAKE DAM
INCREASED FREEBOARD AND SPILLWAY ENLARGEMENT
RECONSTRUCTION OF SCREEN HOUSES

DRAWN BY W.T. Barnes	DATE Sept 17, 1942	D-851-A
TRACED BY	SCALE 1/4" = 1'	
CHECKED BY	APPVD BY	

PHASE I INSPE
NATIONAL DAM INS
SPRING BROOK
PENNSYLVA
AND WATER
OUTLET
APRIL 1980

2

TION REPORT
ECTION PROGRAM

INTAKE DAM

NIA GAS
COMPANY

WORKS

PLATE E-6

3

APPENDIX F

GEOLOGY

SPRING BROOK INTAKE DAM

APPENDIX F

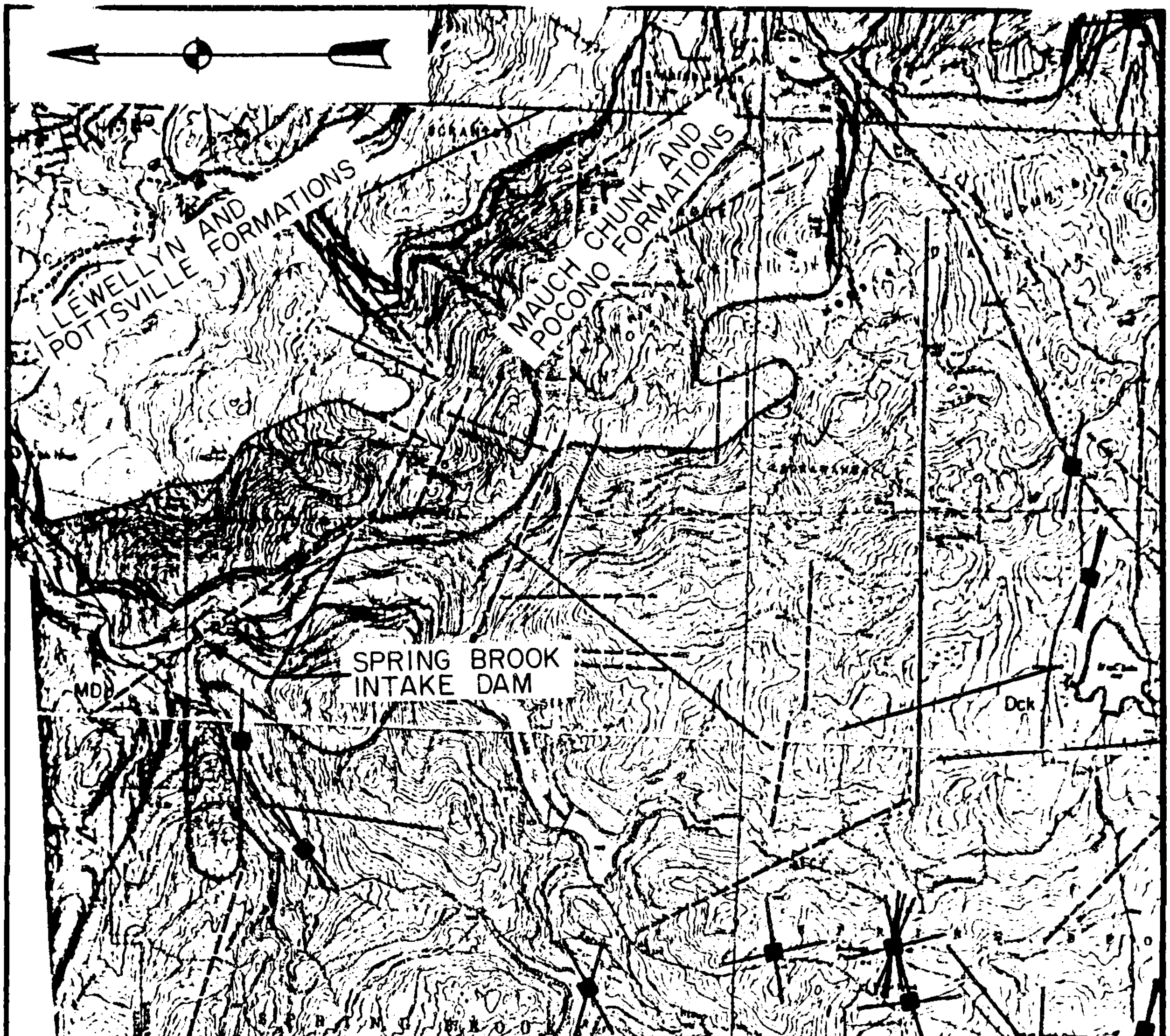
GEOLOGY

Spring Brook Intake Dam is located in Lackawanna County and lies within the Valley and Ridge Province. The Lackawanna Syncline is the most important structural feature in this section of northeastern Pennsylvania. It is a broad canoe-shaped downwarp that trends northeast and southwest from Orson to Orangeville. The rim rocks are of the Pottsville and Pocono Formations; they have dips that are usually 20° or less and form a simple syncline. The core rock is of the Llewellyn Formation; it is folded into a series of minor anticlines and synclines that trend N 70°E. Rock to both the northwest and southeast of the Lackawanna Syncline is usually horizontally-bedded and is part of the Susquehanna and Catskill Formations of the Appalachian Plateau Province.

Bedrock units of the Lackawanna Syncline are the lithified sediments of deltaic, fluvial, and swamp environments. The sediments are of the Mississippian and the Pennsylvanian Periods. The bedrock units include sandstones, conglomerates, and shales of the Pocono Formation; red shales of the Mauch Chunk Formation; and sandstones, conglomerates, shales, and coals of the Pottsville and Llewellyn Formations.

Although the geologic map on Exhibit F-1 indicates the dam to be in the Pocono Formation, more detailed unpublished geologic mapping by the Pennsylvania Geologic Survey indicates the damsite to be underlain by the Upper Devonian, Lower Mississippian Spechty Kopf Member of the Catskill Formation. This formation is composed of sandstone, shale, conglomerate, and coal. The Pocono Formation is exposed on the tops of the hills that surround the site.

The embankment and main spillway of the dam are founded on a sandy gravel, as shown on Plate E-3 in Appendix E. The auxiliary spillway is founded on bedrock, which outcrops at the right abutment.


LLEWELLYN AND POTTSVILLE FORMATIONS
MAUCH CHUNK AND POCONO FORMATIONS
SPRING BROOK INTAKE DAM
MDh
Dck
CATSKILL FORMATION
0 1/2 1
SCALE: 1 IN. = 1 MILE
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
SPRING BROOK INTAKE DAM
PENNSYLVANIA GAS
AND WATER COMPANY
GEOLOGIC MAP
APRIL 1980
EXHIBIT F-1